

## Mineral Contents Analysis of *Cyperus esulentus* (Tigernut)

Igwe, Frances .C. and Eze-Stephen, Peter .E.\*

Department of Applied Biochemistry, Faculty of Applied Natural Sciences  
Enugu State University of Science and Technology (ESUT) Nigeria.

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### ABSTRACT

The objective of this work was to determine the amount of minerals such as, iron, copper, nickel, chromium, zinc, manganese lead, cadmium, calcium, sodium, potassium, cobalt, magnesium, present in tigernut using Atomic Absorption Spectrophotometer (AAS), while gravimetric method was used to determine phosphorus and chloride. The sample for the analysis was prepared by wet digestion method based on the addition of nitric acid followed by oven heating the temperature 150°C. The standard solutions of the above minerals were equally synthesized. These standards were measured in the AAS machine to strike a balance between absorbance against concentration which was utilized in quantitatively determining the amount in prepared sample of tigernut. The result gave the following minerals as Fe 0.002, Cu 0.02, Ni 0.03, Zn 0.038 Mn 0.004, Cd 0.16, Ca 0.047, Na 0.01, K 0.18, Co 0.02, Mg 0.02, P 32.89, Cl 2.24 all in (mg/g).

Keywords: Minerals, contents, analysis, tigernut.

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### INTRODUCTION

Tigernut (*Cyperus esulentum*) is a perennial grass-like plant with spheroid tubers, pale yellow cream kernel surrounded by a fibrous sheath. It is also known as yellow nut sedge, earth or ground almonds. [1] reported that *chufa* came to Spain from Africa. Tigernut is found in the wild and cultivated in Africa, South America, Europe and Asia. It grows along rivers and are cultivated on a small scale by rural farmers mostly in the northern states of Nigeria. It is locally called "aya" in Hausa; "aki awusa" in Igbo; "ofio" in Yoruba and "isipaccara" in Efik. Tigernuts are edible, sweet, nutty, flavoured tubers which contain protein, carbohydrate, sugars, and lots of oil and fiber [2]. [3] showed that tigernuts have been cultivated for food and drink for men and planted for hogs for many years in Spain and that the lovely milky elixir is served in health Spas, Pubs, and Restaurants as a refreshing beverage. Unfortunately, despite these potentials in tigernuts it has been a neglected crop in Nigeria. This probably may be due to inadequate knowledge on its

utilization and nutritional value. It is an important food crop for certain tribes in Africa, often collected and eaten raw, baked as a vegetable, roasted or dried and ground to flour. The ground flour is mixed with sorghum to make porridge, ice-cream, sherbet or milky drink. It is mostly consumed raw as snack without knowledge of the food and nutritional quality [4]. It has also been found to possess good therapeutic quality [5]. Moore stated that "the expansion of tigernut milky drinks will significantly help the research linking tigernut milk to healthier cholesterol levels and other non-dairy manufacturers. This could also gain a boost from an increased consumer interest in healthy foods".

Variety of food products can be derived from tiger nut tubers though there is little-documentation at large. Various food processing techniques can be applied to tiger nut processing to modify its appearance, develop its natural flavour, stimulate the digestive juices, add variety to the menu, make it easily digestible and bio-

available, destroy harmful microorganisms, improve its nutritional quality and prevent

decomposition. This project work intends to basically evaluate mineral contents and utilization of tigernuts

#### STATEMENT OF PROBLEMS

Recognition of food crops with good mineral content has been a serious problem to the nation due to little or no knowledge on most common crops with this mineral value such as tigernut. Though rich in mineral contents, tigernuts have been an underutilized food crop in Nigeria.

It is mostly eaten raw as snack and this food crop has a great potential in improving someone's nutritional status. Adequate nutrition is essential for individual development, activity, good health. Nutritionists have demonstrated that the major nutritional problems could be solved through exploitation of the nutrition and economic potentials of the local food

resources. Tigernut is one of the under-utilized tubers with great potentials for domestic and commercial purposes. There is no documentation of a successful product made from tigernuts in the Nigerian market. A successful product, offers a benefit that is perceptible and valued by the consumer [6]. There is little documentation on the nutritional quality and versatility of tigernuts in food preparation despite its availability. However, tigernut is still one of the least popular tubers in Nigeria and hence the need for this research which intends to evaluate the mineral content and utilization of tiger nuts.

#### OBJECTIVES OF STUDY

The objective of this study is to evaluate the mineral potentials of

*Cyperus esculentum* (tigernut).

#### MATERIALS AND METHODS

##### Sample Collection

Dried tigernut used were purchased from Ogbete main Market in Enugu Stale. Nigeria in February 2018 and

carried to the laboratory in a polythene bag.

##### Reagent Preparation

##### Zinc Chloride Solution (100ppm)

Zinc chloride (0.3g) was weighed using OHAUS weighing balance and was introduced into a 30ml volumetric flask, distilled water (100ml) was measured with a measuring cylinder and introduced into the flask, then shaken to dissolve the zinc chloride. The solution was made up to mark with distilled water. Portions of the solution (2.5ml, 2ml, and 1ml) were separately measured with measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

water (100ml) was measured using measuring cylinder and poured into flask. It was shaken to dissolve the manganese (II) chloride. The solution was made up to mark with distilled water. Portions of the solution (2.5ml, 1.5ml, 0.02ml), were separately measured with measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up mark with distilled water to obtain series of working standards.

##### Magnesium Solution (1000ppm)

##### Manganese Solution (100ppm)

Manganese (II) chloride (0.24g) was weighed with OHAUS weighing balance and introduced into a 1000ml volumetric flask, distilled

Magnesium chloride (0.4g) was weighed with OHAUS weighing balance and introduced into a 1000ml volumetric flask, distilled water (100ml) was measured using a measuring cylinder and poured into the flask. It was shaken to dissolve the magnesium chloride. The solution was made up to mark with distilled water. Portions of the

solution (1.5ml, 1.3ml, 0.8ml), were separately measured with measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

**Calcium Solution (100ppm)**

Calcium chloride (0.3g) was weighed with OHAUS weighing balance and was introduced into 1000ml volumetric flask, distilled water (100ml) was measured with measuring cylinder and poured into the flask, then shaken to dissolve the calcium chloride. The solution was made up to mark with distilled water. Portions of the solution (6ml, 3.2ml, and 1.5ml) were separately measured with measuring cylinder and poured into a 100mL volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

**Iron Solution (100ppm)**

Iron (II) chloride (0.26g) was weighed with OHAUS weighing balance and introduced into a 1000ml volumetric flask, distilled water (100ml) was measured using with a measuring cylinder and poured into the flask, then shaken to dissolve the iron (II) chloride. The solution was made to mark with distilled water. Portions of the solution (5.2ml, 3ml, and 1.3ml) were separately measured with measuring cylinder and poured into a 100mL volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

**Nickel Solution (100ppm)**

Nickel (II) chloride (0.22g) was weighed with OHAUS weighing balance and introduced into a 1000ml volumetric flask, distilled water (100ml) was measured with measuring cylinder and poured into the flask, then shaken to dissolve the Nickel (II) chloride. The solution was made up to mark with distilled water. Portions of the solution (8ml,

4.2ml, 0.7ml) were separately measured with measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

**Chromium Solution (100ppm)**

Chromium (III) chloride was weighed with OHAUS weighing balance and introduced into 1000ml volumetric flask, distilled water (100ml) was measured with measuring cylinder and poured into the flask, then shaken to dissolve the chromium (III) chloride. The solution was made up to mark with distilled water. Portions of the solution (5ml, 2.5ml, 0.7ml) were separately measured with measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

**Sodium Solution (100ppm)**

Sodium chloride (0.26g) was weighed with (OHAUS) weighing balance and introduced in a 1000ml volumetric flask, distilled water (100ml) was measured with measuring cylinder and poured into flask, then shaken to dissolve, the sodium chloride. The solution was made up to mark with distilled water. Portions of the solution (2ml, 1ml, 0.5ml) were separately measured with measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

**Lead Solution (100ppm)**

Lead (II) chloride was weighed with OHAUS weighing balance and introduced into a 1000ml volumetric flask, distilled water (100ml) was measured with measuring cylinder and poured into the flask. It was shaken to dissolve the lead (II) chloride. The solution was made up to mark with distilled water, portions of the solution (21ml, 10ml, 1ml) were separately measured with

measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards,

#### **Copper Solution (ppm)**

Copper (II) chloride (0.22g) was weighed with OHAUS weighing balance and introduced into 1000ml volumetric flask, distilled water was measured with measuring cylinder and poured into the flask. It was shaken to dissolve the copper (II) chloride. The solution was made up to mark with distilled water. Portions of the solution (10ml, 5.5ml, 0.5ml) were separately measured with measuring cylinder and poured into a 100mL volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

#### **Cadmium Solution (100ppm)**

Cadmium chloride (0.16g) was weighed with OHAUS weighing balance and introduced into 1000ml volumetric flask, distilled water (100ml) was measured and poured into the flask, then taken to dissolve the cadmium chloride. The solution was made up to mark with distilled water. Portions of the solution (2ml, 1ml, 0.1ml) were separately measured with measuring cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

#### **Potassium Solution (100ppm)**

Potassium tetraoxosulphate (VI) (0.45g) was weighed with OHAUS weighing balance and introduced to a 1000ml volumetric flask, distilled water (100ml) was measured with a measuring cylinder and poured into the flask; it was shaken to dissolve the potassium tetraoxosulphate (VI). The solution was made up to make with distilled water. Portions of the solution (5.2ml, 3ml and 1.2ml) were separately measured with measuring

cylinder and poured into a 100ml volumetric flask, distilled water (70ml) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

#### **Cobalt Solution**

Cobalt (II) chloride (0.22g) was weighed with OHAUS weighing balance and introduced into a 1000ml volumetric flask, distilled water (100ml) was measured with measuring cylinder and poured into the flask. It was shaken to dissolve the cobalt (II) chloride. The solution was made up to mark with distilled water. Portions of the solution (5ml, 3.5ml, 0.5ml) were separately measured with measuring cylinder and poured into a 100mL volumetric flask, distilled water (70mL) was measured and introduced into the flask. It was shaken vigorously and made up to mark with distilled water to obtain series of working standards.

#### **Sample Preparation**

The sample used for the analysis was crushed in a mortar with pestle to produce homogenized forms of the sample. They were then collected and stored in airtight container until required for use.

#### **Sample Digestion**

The sample was grinded into powder using a clean mortar and pestle. 0.5g of the sample was added to 5.0 cm<sup>3</sup> of concentrated nitric acid (HNO<sub>3</sub>) in a beaker and heated to near dryness at 150°C for six minutes to expel brown gas of NO<sub>2</sub>. The resulting solution was allowed to cool, and dissolved a small portion of distilled water and made up to mark in a 100ml volumetric flask.

#### **Analysis of Copper Ion**

The copper hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 327nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (10ppm, 5ppm, 0.5ppm) were separately aspirated into the instrument and absorbance against concentration standard curve

was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance also generated automatically by the instrument. The copper concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Zinc Ion**

The zinc hollow cathode lamp was setup by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 213.9nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (2ppm, 1ppm, 0.2ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance as also generated automatically by the instrument. The zinc concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Magnesium Ion**

The magnesium hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 285.2nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (1.5ppm, 1ppm, 0.5ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was also generated automatically by the instrument. The magnesium concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Cadmium Ion**

The cadmium hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance

spectrophotometer to give a resonance line of wavelength 228.9nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (2ppm, 1ppm, 0.1ppm) were separately aspirated into instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated distilled water, the sample was then aspirated and absorbance was also generated automatically by the instrument. The cadmium of the sample was extrapolated from the standard curve.

#### **Analysis of Chromium Ion**

The chromium hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 357.9nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (5ppm, 2.5ppm, 0.5ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was also generated automatically by the instrument. The chromium concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Calcium Ion**

The calcium hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 427.7nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (6ppm, 3ppm, 1ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was

aspirated with distilled water, the sample was then aspirated and absorbance is also generated automatically by the instrument. The calcium concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Iron Ion**

The iron hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 372 Ohm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (5ppm, 3ppm, 1ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance as also generated automatically by the instrument. The iron concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Nickel Ion**

The nickel hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 341.5nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (8ppm, 4ppm, 0.5ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was generated automatically by the instrument. The nickel concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Manganese Ion**

The manganese hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength

279.5nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (2.5ppm, 1.5ppm, 0.2ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was also generated automatically by the instrument. The manganese concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Cobalt Ion**

The cobalt hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 322nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (5ppm, 3.5ppm, 0.5pp) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was also generated automatically by the instrument. The cobalt concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Lead Ion**

The lead hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 283.3nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (20ppm, 10ppm, 1ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was also

generated automatically by the instrument. The Lead concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Sodium Ion**

The sodium hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 589.0nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (2ppm, 1ppm, 0.5ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was also generated automatically by the instrument. The sodium concentration of the sample was extrapolated from the standard curve.

#### **Analysis of Potassium Ion**

The potassium hollow cathode lamp was set up by selecting arsenic from the library of the atomic absorbance spectrophotometer to give a resonance line of wavelength 769.9nm. The instrument was aspirated with distilled water to clear the aspiration tube of impurities. Three standard arsenic solution of different concentration (5ppm, 3ppm, 1ppm) were separately aspirated into the instrument and absorbance against concentration standard curve was generated automatically. The instrument was aspirated with distilled water, the sample was then aspirated and absorbance was also generated automatically by the instrument. The potassium concentration the sample was extrapolated from the standard curve.

#### **Chloride Determination**

The sample weighed was 0.2g and was introduced into a 250ml conical flask and 100ml of distilled water was added. It was heated for one hour (1hr) in a boiling water bath and the extract was filtered. Chloride was determined by titration

with  $\text{AgNO}_3$  following [7] 100ml of the water sample was measured into 250ml Erlenmeyer flask. The pH of the water was adjusted to 8.0 using sodium hydroxide. 10ml of 0.1M potassium chromate was added to the solution. The mixture was then titrated with 0.014M Silver trioxonitrate ( $\text{AgNO}_3$ ) until the colour changed from colourless to pinteish yellow as the end point.

#### **Determination of Phosphorus**

The sample weighed was 3g using weighing balance and was transferred into a 250ml beaker and 40ml of distilled water was added and stirred to dissolve the sample. The solution was filtered. 45ml of 10%  $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$  solution was added to the filtrate, 150ml of 2M  $\text{NH}_3$  was added slowly while stirring. The mixture was allowed to settle for 15 minutes at room temperature and the solution was precipitated. Filter paper was weighed and held in a funnel and the solution was transferred into filter paper for filtration and 10ml of 75% isopropyl alcohol was used to rinse the beaker and poured into the filter paper. When all the liquid had gone through, the filter paper with the precipitate was removed placed on a marked paper towel while the filtrate was discarded. The filter paper with Magnesium ammonium phosphate hexahydrate ( $\text{MgNH}_4\text{PO}_4 \cdot 6\text{H}_2\text{O}$ ) precipitate was thoroughly dried in an oven and weighed with the precipitate to the weight of the filter paper after heating.



## RESULTS

**Table 1: The Result of some Minerals contained in Tigernut**

Parameter	Values (mg/g)
Fe	0.002
Cu	0.02
Ni	0.03
Cr	0.00
Zn	0.38
Mn	0.004
Pb	0.00
Cd	0.16
Ca	0.47
Na	0.01
K	0.18
Co	0.02
Mg	0.02
P	32.89
Cl	2.24

## DISCUSSION

Result in the Table 1 shows the mineral content of tigernut using atomic absorption spectrophotometer (Buck Scientific 210VGP) and gravimetric method of analysis. Result gotten shows that phosphorus (32.89mg/100g) is the most abundant followed by chloride (2.24mg/100g) while chromium and lead were not detected. Calcium (0.47mg/100g) and Zinc (0.38 mg/100g) were the next after phosphorus and chloride. Iron (0.002 mg/100g) and Manganese(0.004 mg/100g) were the least in the result obtained. The result obtained also indicate the presence of other minerals which are the following: Copper (0.02 mg/100g), nickel (0.03 mg/100g), cadmium (0.16 mg/100g),

sodium (0.01 mg/100g), potassium (0.18 mg/100g), cobalt (0.02 mg/100g) and magnesium (0.02 mg/100g).

Oladele and Aina (2007), reported the mineral element of tigernut flour. Their result showed that sodium had a value of (245 mg/100g), potassium (216 mg/100g), calcium (155 mg / 10g) while phosphorus was (121 mg/100g). Other minerals present are zinc (0.01 mg/100g), iron (0.65 mg/100g) and copper (0.02 mg/100g). These values are higher than what was found in this work except copper which has exact value with what was found in this work and zinc which was lower than what was found in this work.

## CONCLUSION

Although tigernut is known to be an underutilized food crop but this study has revealed that tigernut (*Cyperus esculentus*) contain the following minerals: phosphorus, chloride, sodium, calcium, magnesium, potassium, cobalt, copper, cadmium, zinc, manganese,

nickel and iron. From the result of the study, it can be evidently concluded that tigernut is a very good source of some mineral components as mentioned. With these minerals present, it would also serve as useful dietary supplements.



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