ANALYTICAL ASSESSMENT OF ELEMENTAL CONTENTS OF *Ximenia Americana* (WILD PULM) AND *Sclerocarya birrea* (MARULA) WILD FRUITS

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A PROJECT SUBMITTED TO THE DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY, COLLEGE OF SCIENCE AND TECHNOLOGY, ADAMAWA STATE POLYTECHNIC YOLA. IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS FOR THE AWARD OF NATIONAL DIPLOMA IN SCIENCE LABORATORY TECHNOLOGY.

DECEMBER, 2017

DECLARATION BY THE CANDIDATES

We hereby declare that this project work entitled "Analytical assessment of elemental composition of *Ximenia American* and *sclerocarya birrea* in Hong Local Government Area of Adamawa State is bonifide and genuine research work carried out by us under the guidance of Mr. Maspalma Godwin.

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APPROVAL PAGE

This is to certify that the project titled 'Analytical Assessment of Elemental Contents of *Ximenia Americana* and *sclerocarya birrea* wild fruit was carried out by Farida Adamu Isa, Maryam Jibrilla, Sulaiman Lawan and Abdurahman A. Tanko in partial fulfillment for the award of national diploma (ND) in Science Laboratory Technology, Adamawa State Polytechnic, Yola.

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DEDICATION

This project is dedicated to Almighty God for giving us knowledge and understanding, and also for seeing us through from the beginning to the end of this project work, and also to our parent beloved parents Malam Adamu Isa, malam Adamu Abdullahi, Malam Jibrilla, Malam Lawan, and Malam Abdulhamid Tanko, for their love, care, financial and moral support.

ABSTRACT

The seeds of ximenia Americana (wild plum) and Sclerocarya birrea (marula) were evaluated using standard analytical methods for its elemental composition. Appreciable amount of sodium, potassium, calcium and magnesium respectively have been found in the seeds of the two wild fruits. The results of indicate that, the seeds are good source of both macro and micro elements with Sodium as predominant. Cadmium and Lead were below detection limit of the instruments and hence were not detected in both seeds. The seeds are good source of essential element.

LIST OF TABLES

TABLE OF CONTENTS

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Greater attention has been paid for food and nutrition in the last few decades. This is because of the critical roles of food and nutrition in human development (Ali, 2009).

Most food are made up of several simple substances which are called nutrients and it is the nutrient content of a substance that determine how useful a food will be to our body. They provide energy and material for growth, repair, reproduction, regulation, transportation and cellular activity. Food varied in source and in nutrient contents, one of such source is fruits. Fruits are succulent parts of plants characterized by sweet or acid taste with a distinct flavor (Brian and Cameroun, 1989).

Fresh fruits attract men and animals to consume them, and so were among the original foods of the human race, particularly because they are mostly edible raw. Apart from the pleasure which fruit gives, it plays a very important role in nutrition and health (Sigmund and Guster, 1990).

1.1.1Description of plants

Ximenia Americana, (wild plum) is a medicinal plant that is bushy and spiny shrub; it is 4-5metres high with an open crown. The fruit are green but turn golden yellow or red when ripe. The fruit when eaten is refreshing and has an almond acid taste. The plant is found from Senegal to Cameroon including Northern part of Nigeria (Arbonnier, 2004). The plant is used in traditional medicine for treatment malaria, fever, and skin infection by mixed origin in northern part of Nigeria (Ogunleye and Ibitoye, 2003).

Sclerocarya birrea, "Marula" is a savannah tree belonging to the order, *Sapindales*, family *Anacardiacaea*, deciduous tree; it is up to 15metre high with well-formed light green grown. Their fruit are glabrous yellow drop, 3-4 diameter, stone thick, the fruit pulp is fibrous if ripe (fallen). Fruit when eaten in large amount by human or animal may be intoxicated (Mariod et al.,2008). locally the tree requires sandy or an alluvial soil, its propagation is with seed or cutting. The fruit are used in the liqueur amarula. The distribution of this species throughout Africa has followed the bantu in their migration, as it has been an important item in their diet since time immemorial (Wicken, 2008).

1.2 Statement of the problem

Many people consumers these wild fruit without knowing their mineral values. The drive for search of new, cheap, readily available and sustainable source of nutrients of plant origin have been all encompassing. In this regard we

thought the nutritional valve of *Ximenia Americana* and *Sclerocarya birrea* should be investigated.

1.3 Aim and objectives of the study

The major aim of this study is to evaluate the elemental component of Ximenia *Americana* and *Sclerocarya birrea* wild fruit seed.

Specific objectives of the study are:

- To determine the elemental composition of ximenia *Americana* and *sclerocarya birrea* wild fruit seed and chemical elements to be analyzed include: Sodium (Na) and Potassium (K) by flame emission Spectrophotometer, (FES). Calcium (Ca) and Magnesium (Mg) were determined by titration using the multidentate completing agent EDTA (ethylenedinitritotetraacetic acid or ethylenediaminetetraacetic acid) using the eriochrome Black T as indicator and Iron (Fe), Zinc (Zn) by Atomic absorption spectrophotometer (AAS).
- Identification of the plant specimen for its botanical, common and local name.

1.4 Scope and limitation

The research work was carried out on two selected wild fruits found within Hong, Local Government Area of Adamawa state. The analysis was limited to only elemental composition of the two selected plant fruit seed.

1.5 Significant of the study

- It will enable government to develop research policies to identify and evaluate new underutilized sources of nutrients of plant origin.
- It will help to recommend them as useful regular sources of good nutrient for good health.
- The consumer in need of supplement from wild fruit can make choices of eating any of these fruit based on nutritional needs.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Literature review

In response to the predicated world shortage of food, considerable research has been directed towards expanding present supplies and exploring new sources (Arbouniet, 2004).

The wide spread use of locally available food in Nigeria is limited by the virtual lack of adequate information on their chemical and biological values. Knowledge of chemical composition of food is essential in the dietary treatment of diseases or in any quantitative study of human nutrition. Both of this has become increasingly important in recent years and there has in consequences been a demand for better and more up to-date information about the chemistry of food.

There are list of fruits seed and nuts that grows along the west coast of Africa consumed by men. Some are used for medical purposes but only quite are harmful. The tropical fruits and seeds do not seem to contribute a large portion in human diet as for now. For example; Walnuts, Coula, Edulis, etc. are eating by most people out of hand eat Edulis. Some eat them in salad or in sandwich. However, information about its chemical composition is scanty. The study carries out on the element composition of walnut and the results obtained are shown below.

Table 1.0: Element composition of the Walnut, Coula and Edulis.

Element	Mg/100g dry weight
Calcium	65.75g
Magnesium	13.50g
Potassium	612.50
Zinc	5.03g
Copper	0.15g
Iron	15.00g
Phosphorous	339.26g
Sodium	2.30g

(Calvino and Paulo, 1981).

Relatively high level of phosphates, potassium and magnesium were found. While the level of copper and sodium was low. Information about edible common fruits is also sparse. For example, calcium levels are as follows; guava (23mg/100g), Raspberries (26mg/100g). Similarly, phosphorous is (26mg/100g) in banana, and 8mg/100g in pineapple and 2mg/100g in straw berries.

Recently, the mineral elements and the ascorbic and contents in the fruit of some selected wild fruits were investigated. Considerable high levels of ascorbic acid were found in sclerocarya birrea (marula) and adesonea digitata (baobab) i.e. 403.3mg/100g and 337mg/100gof fruit mesocarp respectively. High level of calcium and magnesium were found in zizyphus Mauritania (Chinese date tree) i.e. 712.55mg/100g and 227.0mg/100g respectively.

The iron levels were relating low, 2-5 times higher than the value in common fruit. The chemical composition of papaya seed was also study. Crude protein was higher in the sarcotesta than in the endosperm that is 30.54 ± 1.02 % and 20.49 ± 0.79%. The mineral elements contents were also general lower in the endosperm than in the sarcotesta - it was 1.80 ± 0.2% in the endosperm.

The study of the chemical composition of some organic compound was carried out in reverse osmosis concentrated citrus juices. Calcium and magnesium were 57.5 and 81.3mg/ kg respectively in the feed and 58.0 and 81.5mg/kg respectively in the concentrate of the orange juice. In grape juice valve were 39.2 and 119mg/kg in the concentrate respectively. According to Mariod et al., (2008) sclerocarya birrea (marula) fruit is rich in sugar and vitamin C contain 2-3 edible kernel of marula are also rich in oil and protein contain. The seed is a potential source of protein (36.7%) which is higher than that of soya bean (33.2%) and peanut (30.0%). The amount of essential amino acid found in *sclerocarya birrea* were higher than those reported by FAO (1988) and the percentage of Sulphur containing amino acid were 4.3% (Mariod et al., 2008).

Arbounier, (2004) reported that *Ximenia Americana* can be used medicinally for the treatment of fever, stiffness, orchocerciasis sore, throat, asthma and headaches. Fruit nutrients fall according to their roles, namely carbohydrates, proteins, fats, minerals, vitamins and water.

The energy valve of a food is derived from the sum of its carbohydrate, fat, and protein contents (Eromosele, et al., 1993) carbohydrates are mostly compound of carbon, hydrogen and oxygen. Some carbohydrates contain other elements such as nitrogen and Sulfur but in a minute form. They can be considered as aldehyde or ketone derivatives of polyhydric alcohols and compounds, which yield these derivatives upon hydrolysis cellulose, starch and ordinary sugar, are all carbohydrates. They provide energy, structural support and function in the genetic control of development and growth of living cells.

Fats and fats-like substance of plant and animal source provide energy in the body in a more concentrated form. They serve also as structural components of cell membrane, as regulators of metabolism and emulsifying agent. Most lipids contain fatty acid as part of their moiety. Proteins are polymeric units of amino acids and therefore serve as a source of these acids which are required for growth, tissue repair and development.

Vitamins, like the hormones, help to regulate body processes; they are supplied in the diet from fruit and vegetables. They serve as precursors of co enzymes are synthesized in the body, vitamins fall into two classes; water soluble and fat soluble. The water soluble vitamins are the B-Vitamins and vitamin C both of which are co enzymes required for the activation and function and functioning of enzymes.

The fat-soluble vitamins are vitamins A, D, E and K. various minerals, both trace and major occur in different proportions in different foods. They form an essential part of the human body and function interdependently of each other with overlapping roles. The common mineral elements of fruits include calcium, magnesium nitrogen, phosphorous, sodium and potassium. The other trace element includes iron, cobalt, copper and manganese. Calcium is the most abundant in the body and essential component of living cells. It is a structural mineral which responsible for the hardness and strength of skeleton and teeth.

Magnesium is concentrated in the mitochondria, it is essential for the activation of several important enzyme reactions, include those that transfer phosphate from adenosine triphosphate (ATP) to adenosine diphosphate (ADP), ATP-ADP reaction are basic to all life processes (herbs 2000com). Cardiac, skeletal and nerve transmission must have a correct balance of calcium and magnesium in order to function properly. Nitrogen is the principal constituent of all plant and animal protein required for body building. It is also converted into nitrogen compounds for industrial and agricultural uses.

Phosphorous teams with calcium to give bones and teeth their rigidity, skeletal tissue contains about eighty percent body's phosphorous. The rest resides in the body fluids and in every cell in the body. Every metabolic process in the body requires phosphorous, include muscle energy production,

carbohydrate, fat, and protein metabolism, blood chemistry fatty and transport, and numerous enzymes system (Herbs 2000.com).

Potassium is one of the most abundant mineral in the human body. Many cellular enzyme systems depend on it, and nerve excitation and muscular contraction are influenced by potassium. It is removed from many processed foods. In fact, many of the same processing steps that remove potassium also add sodium.

Sodium is very important, yet very dangerous mineral. It is dangerous mainly because modern food technology insists on adding sodium compound to processed and manufactured foods. Sodium's primary purpose is to help pump fluids and nutrients in and out of the cells and cell membranes. The fluid outside the cells contains most of the body sodium, (Herbs 2000.com).

CHAPTER THREE

3.1 Material and methods

All glass and plastic ware washed clean with detergent solution and then rinsed thoroughly with distilled water (henceforth water) before immersion in 10% nitric acid solution for a day and then again rinsed with water and finally dried in oven at 105°C, each container was rinsed with the solution to be stored or taken in before use.

3.2 Apparatus and instruments

- Mortar and Pestle. Glass rod. Crucible glass. Watch glass. Spatula. Pipette 0.1ml, 5ml, and 10ml.Volumetric flask 100ml and 250ml.Burette. Beakers 250ml, 500ml.Filter paper. Clamps. Polythene bottle (sample bottle). Measuring cylinder. 10ml, 50ml, and 150ml. Distillation apparatus. Conical flacks, 100ml, 250ml and 150ml. Kjeldhal flacks, 250ml and 500ml.Fume cupboard. Hot plate. Muffle furnace. Heating mantle. Analytical balance. Atomic absorption spectrophotometer (pye unicam SP.9).

3.3 Reagents

- 2M sodium hydroxide. Potassium chloride. 0.01m EDTA. Buffer solution. Nitric acid. HNO_3 70%. Per chloric acid $HClO_4$, 60%.0.2m hydrochloric.0.2m sulphuric acid. Erochrome black T. indicator.98%

sulphuric acid. Sodium sulphate. Zinc metal (granulated). Copper Sulphate. Litmus paper (Neutral). Methyl red indicator

3.4 Description of study Area

The study area lies within longitudes 12°50 E to 13°00 E and latitude 10°05 N to 10°22 N. The area falls within Hong Local Government Area of Adamawa State, North-eastern Nigeria and is accessible through Gombi- Mubi road, Hong- Garaha road and Hong-Gaya road. Hong and environs are drained by Kilanye and Shashau Rivers (Bassey *et al.*, 2006). The area is characterized by dry season (October to March) and wet season (April to September). The area falls within the Sudan Savannah vegetation type which consists of shrubs, grasses and trees especially along the river channels (Dada, 2006). Physiographically, the area falls within the Adamawa highlands with rugged hills and heights of between 800 and 1500 m above sea level that forms inselbergs and whalebacks.

3.5 Sample collection

Fresh and ripe *Ximenia America* (wild plum) and *sterocarya birrea* (Marula) were collected in June, 2017 from Pella, Hong Local Government of Adamawa State Nigeria and was taken to Department of Science Laboratory Technology, Biology unit of Adamawa State Polytechnic Yola for identification by a Botanist.

3.6 Sample treatment

The representative sample were thoroughly washed with distilled water and were skinned and the seeds were oven dries at 110°c for 24hours. They were crushed in a mortar and ground into powdered form. This was quartered to give a reasonable sample of about 18g each. They were stored in sample bottle. Prior to analysis.

3.7.0 Preparation of solution

3.7.1 Preparation of ammonium chloride buffer solution

A 17.5g of Ammonium Chloride was dissolve in 57/of ammonia solution and diluted to the mark in a 100cm^3 volumetric flasks with distilled water. The pH of the solution was measured using a pH meter. The solution was stored in polythene bottle for use.

3.7.2 Preparation of 0.01m EDTA solutions

A 0.3722g of sodium hydrogen ethylene diamine tetra acetate (EDTA) was dissolved in distilled water and diluted up to the mark in 100cm^3 volumetric flasks. The solution was freshly prepared prior to use.

3.7.3 Preparation of 50% sodium hydroxide

A 50g of sodium hydroxide was dissolved in distilled water and made up to the mark in100cm^3 volumetric flasks

3.7.4 Preparation of 0.2 m sulphuric acids

A 2.66cm^3 of 98% (m/m) H_2SO_4 was dissolved in distilled water and made up to the mark in 500cm^3 volumetric flasks

3.8.0 Digestion of samples

3.8.1 Wet digestion

A 1g of powdered sample was weighed and transferred into a 250cm^3 Kjedhal digestion flask followed by addition of 20cm^3 of concentrated nitric acid. The solution was stirred and allowed to stand over night after which 10cm^3 of per chloric acid was added and heated gently at first, then more vigorously until a clear solution was achieved. The solution was cooled and transferred to 100cm^3 volumetric flasks and diluted up to the mark with distilled water. The solution was mixed thoroughly and then filtered and was kept in the polythene (sample bottle).

3.9.0 Determination of procedures

3.9.1 Determination of calcium

2cm^3 of the sample solution was taken and the sample 2.5cm^3 of 2M sodium hydroxide and a pink of screened murexoxide indicator was added. This was titrated against 0.01m, EDTA with a color change from pink to purple.

A black titration was carried out in similar manner using distilled water instead of the sample from the relationship.

The concentration of 1cm^3 EDTA = 0.4008mg Ca. of calcium in the sample was determined.

3.9.2 Determination of magnesium

2.5cm^3 of butter solution (with pH = 95) and a pinch of Erochrome black T. indicator were added to 5cm of the sample solution. This was titrated with 0.01m EDTA. The end point was marked by change from red to blue for magnesium and calcium in the sample. The concentrating of magnesium was determined by subtracting the titer value obtained for calcium from that obtained from the combined value.

3.9.3 Determination of Iron, copper, zinc, manganese, cadmium and lead

A pye - unicam sp-9 atomic absorption spectrophotometer equipped with a digital read out and deuterium are background convection system was used for the determination of the metals. Acetylene was used as fuel. A hallow cathode lamp for each element was employed.

The instrument was switched on and was allowed to establish for 30minutes. The current and resonance line wavelength were selected. The gas control system was turned on and the flow rate adjusted. It was ignited and allowed for a few minute to establish the flame.

The blank, standard and sample digest solutions were aspirated and the absorbance readings recorded. A calibration curve was constructed by plotting

the absorbance of the standards against their corresponding concentrations. The nebulizer was rinsed by aspirating water containing 1.5cm^3 HNO_3 per litter. After the readings of the blank standard and sample solutions, the instrument was zero after each set of solution (Balance, 1996). Each element was determined using its own lamp. The respecting wavelength of Fe, Cu, Zn and Mn use 48.2, 324.7, 279.5 and 232.0 respectively.

The absorbance reading for both standard and sample were corrected using the reading for the blank. The amount of each element in the sample was interpolated using its respective calibration curve.

3.9.4 Determination of sodium and potassium

Flame emission spectrometer (FES) series 410 equipped with a digital read out system was used. The minimum detection level for both potassium and sodium was approximately 1mg/l. the upper limit was approximately 10.0mgl^{-1} but thus may be extended by diluting the sample (Sexena 1990). Dilutions were made form 1000mg/l sodium stock solution. 10cm^3 of the aliquots was pipetted into a 100cm^3 volumetric flasks and diluted to mark with water to obtain 0, 0.5, 1.0, 1.5, 2.0, 2.5 and 3.0mg/l.

The instrument was switched on and allowed to stabilize for 30minutes. The selected filter for sodium determination was set at 589nm and the compressor started. The burner was ignited with the gas on and the slit width, sensitivity

fuel and air pressure was adjusted to give a blue flame. The meter was then zeroed using distilled water and both the standard and sample solution were spayed one after the other and their respective emission intensities were recorded. Tree separate readings for the sample were taken and their average computed. From the calibration curve of the intensities against corresponding concentrations, the sodium contents of the sample were interpolated and expressed per sample weight taken for use. Potassium determination was carried out similarly at 799.5nm.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

Table 2.0: Identification of plant specimen

	English Name	Botanical Name	Hausa Name	Fulfulde Name	Kanakuru Name	Kilba Name	Tiv Name
1.	wild plum	Ximenia Americana	Ishada	Chabbule	Darini	Tsanzira	Amako
2.	Marula	Sclerocarya Birrea	Melina	Edchi	Bawu	Kwakudahya	Melena

Table 2.0 and 3.0 shows the identification of plant specimen for its Botanical, Common and Local names and mineral element contem of the seed respectively.

The mineral elements analyzed are shown in table 3.0 cadmium and lead were absent in both seeds. Their absence may be due to their extremely low level in the soil and low uptake by the plants into the fruit parts. The level of all the elements detected, expect zinc where found to be higher in Ximenia Americana. The result obtained in this study compared relatively well (in most cases) when compared to the values reported in the literature by several workers on wild plant seeds. Sodium showed the highest value of 925.20mg/100g in Ximenia

Americana and 664.30mg/100g in Sclerocarya birrea. Potassium also showed high value of 564.00mg/100g in Ximenia Americana and 213.40mg/100g in

Table 3.0 Mineral element content of the seed (mg/100g dry weight)

Element	Ximenia Americana	Sclerocarya Birrea
Mg	142.10	12.00
Ca	323.00	145.60
Mn	23.30	19.00
Fe	70.0	47.61
Na	924.20	664.30
K	564.00	213.40
Cu	20.50	41.20
Zn	40.1	37.30
Cd	ND	ND
Pb	ND	ND

ND =Not detected

Sclerocarya birrea, its value of 213.40mg/100g was lower than 278mg/100g reported in prosoppis Africana (Barminas et al., 1998). The high value of potassium is reported to have direct relevance to disease control, in addition to regulation of processes as synthesis, translocation and storage of protein and

carbohydrates. The soil contains low quality of potassium and its high content in the seeds, therefore suggested that the plant is exhaustive, that is depleting the soil of the nutrient.

Calcium is very essential for proper bone formation and magnesium for the activation of several important enzyme reactions. Higher value of calcium and magnesium were obtained in both seeds, although the value of calcium 323.00mg/100g in Ximenia Americana was higher than 145.00mg/100g obtained for Sclerocarya birrea.

One can observe that our data were higher for Na, similar for K and lower for the trace element analyzed. Except for Cu (41.20mg/100g), which was higher in Sclerocarya birrea than Ximenia Americana (20.50mg/100g). The highest value of mineral element was found in Ximenia Americana starting with Na followed by K, Ca, Mg, Fe, and Zn showed the lower value, in decreasing order and the lowest were Mn and Cu. These results show that these fruits eaten raw are good source of essential nutrients.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The elemental composition in table 3.0 for Ximenia Americana and Sclerocarya birrea shows that the habit of eating these fruit raw by Nigerians has some nutritional advantages and should be encouraged. Their recommended human consumption will help check deficiency related diseases that affect growth and normal body activities associated with comities in developing countries.

5.2 Recommendation

It is recommended that further investigation be carryout to cover elements like phosphorus, nitrogen as well as carbohydrate, fat and vitamin C content of these fruits and their seeds.

It is also recommended that different analytical method be employed to investigate the elemental composition of these fruits and their seeds.

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