DETERMINATION TRACE ELEMENTS IN RAW FLUTED PUMPKIN

(TELFERIA OCCULEATALIS)

BY

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CERTIFICATION

This is to certify that this project is the original work carried out and reported by Sulaimon Aminat Oyinoza with matric Number ND/23/SLT/PT/0413 to the Department of Science Laboratory Technology, Institute of Applied Sciences (IAS), Kwara State Polytechnic, Ilorin and it has been approved in partial fulfillment of the requirement for the award of National Diploma in Science Laboratory Technology.

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DEDICATION

I dedicate this project to Almighty God my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this program and on His wings only have I soared. I also dedicate this work to my Parent; **MR & MRS SULAIMON** who has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started may almighty **God** enrich your pocket and live long to eat the fruit of your labor. To my Brothers and Friends who have been affected in every way possible by this quest.

Thank you. My **love** for you all can never be quantified. **God** bless you

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ABSTRACT

The relevance of trace element analysis cannot be overstated, especially in regions where malnutrition and micronutrient deficiencies are prevalent.

This study was conducted to determine the trace elements composition of *Telfairia occidentalis* (fluted pumpkin). The trace elements were determined using an Atomic Absorption Spectrophotometry method. The results revealed the presence of essential micronutrients such as Copper and Zinc which their values fall within permissible dietary intake limits. Nickel was not detected in the analyzed samples. The findings highlight *Telfairia occidentalis* as a nutritious and safe leafy vegetable capable of contributing to micronutrient intake, which are crucial for immune and enzymatic functions,

CHAPTER ONE

1.0 INTRODUCTION1

In culinary terms, a vegetable is an edible plant or its part, intended for cooking or eating raw. The non-biological definition of a vegetable is largely based on culinary and cultural tradition. Apart from vegetables, other main types of plant food are fruits, grains and nuts. Vegetables are most often consumed as salads or cooked in savory or salty dishes, while culinary fruits are usually sweet and used for desserts, but it is not the universal rule. Therefore, the division is somewhat arbitrary, based on cultural views. For example, some people consider mushrooms to be vegetables even though they are not biologically plants, while others consider them a separate food category; some cultures group potatoes with cereal products such as noodles or rice, while most English speakers would consider them vegetables.

Some vegetables can be consumed raw, while some, such as cassava, must be cooked to destroy certain natural toxins or microbes in order to be edible. A number of processed food items available on the market contain vegetable ingredients and can be referred to as "vegetable derived" products. These products may or may not maintain the nutritional integrity of the vegetable used to produce them.

(Telfairia occidentalis HOOK. F., Family: Curcubitaceae) probably originated from the south eastern Nigeria, and is widely distributed among the Igbo speaking people, particularly around Imo state, Nigeria (Esiaba, 1982; Burkill, 1985; Akoroda, 1990a), where it has the widest diversity (variation in pod and seed colour, seed and plant vigour, anthocyanin content of leaves and petioles or shoots, leaf size and their succulence, dioecious or monoecious plants) (Chewya and Eyzaguirre, 1999; Chinhande et al., 1997).

Leaves are spirally arranged, with 3-5.5 cm long while female flowers are solitary in leaf axils; they are 5- merous and cream coloured; fruit is drooping, ellipsoid berry 40- 95 cm by 20-50 and weighs about 10 kg; seedS are compressed ovoid about 4.5 cm long, black or brown – red (Grubben and Denton, 2004; Pursglove, 1991). It is a herb climbing by coiled, often branched tendrils to a height of over 20 M. The root system rantify the top surface of the soil, stem is angular glabious and fibous when old. There are two main varieties in Nigeria: Ugu-ala (succulent, broad leaves, mall black seeds about 12 g, a thick vine and slow growth); Ugu-elu (high growth rate, large brown coloured seeds of 20 g or more, fast emergence, thin stems and small leaves) (Omidiji, 1997; Chweya and Eyzaguirre, 1999; Odiaka, 2001). A third cultivar, Nsukka local was selected from local land races and is tolerant to root knot nematodes. It is widely cultivated in the West and Central Africa (Benin Republic, Cameroon, Nigeria, Sierra Leone to Angola, and up to Uganda in east Africa). It is called 'ugu' by the Igbos, 'ugwu' by the Yorubas and 'ekobon' by the Cameroonians (FAO, 1988; Schippers, 2002; Grubben and Denton, 2004). It has a close relative, Telfairia pedata (Sims) Hook which used to be cultivated in Ethiopia, Kenya, Madagascar, Malawi,

The trace elements found in vegetables, including zinc (Zn), iron (Fe), copper (Cu), selenium (Se), and manganese (Mn), though required in minute quantities, play critical roles in human physiological and biochemical processes. Their adequate intake is essential for optimal immune function, antioxidant defense, enzymatic reactions, and prevention of various micronutrient deficiency-related diseases (Guzzetti et al., 2021). However, the concentrations of these elements in plants are significantly influenced by environmental factors such as soil composition, water availability, and agricultural practices, including the type and level of fertilization applied (Yadav et al., 2021).

The relevance of trace element analysis cannot be overstated, especially in regions where malnutrition and micronutrient deficiencies are prevalent. Micronutrient deficiencies, often termed 'hidden hunger', affect over two billion people globally, with a significant proportion residing in sub-Saharan Africa and South Asia (WHO, 2023). In such contexts, promoting the cultivation and consumption of indigenous vegetables rich in bioavailable trace elements presents a sustainable strategy to enhance dietary diversity and nutritional security (FAO, 2022).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 ECOLOGY, GROWTH AND DEVELOPMENT

Fluted pumpkin grows best in warm humid tropics. It is a rain fed crop but can be grown under irrigation (2-3 irrigations per week). It is a perennial but can be gown as an annual under limited rainfalls. Seed size affects vigour and seedling germination (Grubben and Denton, 2004). Viability is about 63-89% and germination takes 7-14 days. Large seeds show good growth potential (number of leaves, branches and uniformity of seedlings). Fruit growth is sigmoid over 8 weeks, but is rapid between 1.5- 5.5 weeks. Physiologically mature fruits are obtained 9 weeks after fruit set.

2.2 PRODUCTION AND MANAGEMENT

During the rainy season, staking is commonly practiced to reduce disease infection. Plants are staked individually or, for fruit production. During the dry season staking is not needed for crops and for leaf production because there is less disease attack. Staking does not havea significant effect on the yield of leaves. Because of the prolific nature of the plant, weedsare not troublesome. Planting on flat land is the best method of weed suppression. About three weeding may be required in a staked crop during the rainy season. During the dry season when plants are not staked, two weedings are needed before the leaf canopy suppresses most weeds. Mulching can be used as a method of weed control and to retain soil moisture. The first pruning is 4 weeks after emergence to stimulate branching and increase the growth. Irrigation is necessary for high leaf or fruit production especially under sole cropping in the dry season. Watering is done once every 3 days. Organic manure or inorganic fertilizers are used in traditional systems, but for an optimal leaf yield the recommended fertilizer application is 100 kg K2O and 50 kg P2O5 per ha. In southern Nigeria application of P was found to be especially important, as N and K only increased yields in combination with application of P. Female plants are more vigorous than male ones and produce higher vegetative yields. (Grubben and Denton, 2004).

2.3 HARVESTING

Harvesting begins about one month after emergence and is continued at 2-4 week intervals when new shoots are formed (depending on the cultivar, management practice, and environmental conditions) (Asiegbu, 1983). Harvesting is done by pruning with sharp knives just beneath the lowest acceptable leaf. Harvest interval has no effect on the life span of the crop, as this depends on level of irrigation. Commercial production in Nigeria is from November to July, with 20 or more harvests. Fruits (pods) are harvested 9 weeks after fruit set (Adetunji, 1997). Generally, female plants give higher yield than males ones (their leaves are larger, and vines are stronger, also they keep growing when flowers appear, which is not the case for males). If planting is specifically for young shoots and leaves, early removal of young flower buds is advantageous (Akoroda et al., 1989; Akoroda and Adejoro, 1990; Akoroda, 1990b). Fresh shoot yield could be as low as 500-1,000 kg/ha, but with good management, it could be as high as 3-10 t/ha (good irrigation, adequate fertilization). Seed yield could be up to 1.9

t/ha obtained from 3,000 fruits. The productive span is about 6-8 months. The plants will sprout again when rains set in (Schippers, 2002).

2.4 PROCESSING AND PRESERVATION

The harvested succulent leaves can only remain fresh for one day. Leaves are harvested and packed in jute bags. This may be stored in jute bags for up to 3 days in a well-ventilated condition. Larger bundles are wrapped with plantain leaves or loosely covered with old jute sacks and sparingly sprinkled with water for freshness (Asiegbu, 1983; Grubben and Denton, 2004). When it is not possible to bring fresh leaves to the market, due to oversupply or because the farm is too far, the leaves may be blanched and then dried. The dry leaves are in demand during the dry season (October to January) when fresh leaves are scarce (Badifu, 1993). Fruits are harvested and stored in an open shade for 1- 2.5 months. The fruits are graded before being sold. Seeds are left in the fruits until they are used for planting or consumed. Most of the fruits are transported by rail from the eastern to the middle belt and northern part of Nigeria. Collection and presentation of different fluted pumpkin accessions is being done in West and Central

African Countries. Some level of varietal selection is taking place in Nigeria and Cameroon (Odiaka, 2001; Grubben and Denton, 2004).

2.5 MARKETING

Fresh succulent leaves are preferred by consumers; hence traders transport their product over long distances prefer smaller and less succulent leaves that are less perishable. The shoots are sorted out into lengths and tied into bundles. Care is taken to avoid breaking the stems. Large bundles are offered for whole sale, while the smaller bundles are sold as retail. The shoots are stored under the shade and water is sprinkled on it at intervals to keep itfresh. Watering is done minimally to avoid rotting of the leaves. The leaves are also transported by road from the south to the big cities in the northern Nigeria. Fruits are sold as mature or immature stage (about USS1.0-1.5) (Grubben and Denton, 2004). They are the source of seed for planting. The immature fruit is sold for its unripe seed that is appreciated as food. Fruits are found in all major markets in Nigeria and Cameroonduring the dry season (Odiaka, 2001). Most 0f the fruits are transported to the middle-belt or far north of Nigeria.

2.6 NUTRITIONAL VALUE

Telfairia seeds and leaves have lots of nutritive value. These make the leaves potentially useful as food supplements (Oderinde et al., 1990). The moisture content of the leaves show large variations and is a function of the cultivar plant age, environmental factors, and management practice.

The young leaves contain the anti-nutrients cyanide at 60 mg/100 g dry matter and tannins at 41 mg/100 g dry matter. The leaves contain adequate vitamins A and C. Mineral content of the seed is fairly high. The seeds are high in essential amino acids (except lysine) and are comparable with that of soybean meal with 95% biological value. The fruit pulp is about 1.0% protein and the seed oil is made up of oleic acid (37%), stearic and palmitic acid (21% each), linoleic acid (15%).

2.7 USES

The leaves and seeds are used as vegetables. The tender leaves, succulent leaves and immature seeds are cooked and consumed as vegetable. Leaves may be used alone or together with okra, dika nut (Irvingia sp.) or egusi seeds (Citrullus lanatus (Thunb.) Matsum. & Nakau. Sometimes they are mixed with 'eru' (Gnetum afvricanum Welw.) and Pterocarpus soyauxii Taub. They may also be cooked with fish, meat and tapioca, and are then eaten with pounded yam, ‘eba’, ‘apu’ and ‘amala’ etc. These are favourites throughout Central and Southern Nigeria (Grubben and Denton, 2004; Schippers, 2002). Sometimes male flowers are picked for consumption together with the shoots and leaves. When the leaves are becoming coarse, they are often mixed with other vegetables such as waterleaf (Talinum fruticosum).

The immature seeds are shelled and the kernels are eaten boiled or roasted and used as snack. To ease seed shelling, the seeds are boiled for about 30-60 minutes. This is then added to the soup in ground form (Schippers, 2002). Mature seeds are first washed to remove the dye found in the cotyledon. They are less tasty, but are good sources of edible oil. Ground seeds are used in making cakes which are high in protein and are suitable for fortifying foods, while the oil is served as cooking oil and for making margarine. The oil can also be used as drying oil for paints and varnishes (Grubben and

Denton, 2004). Pregnant women and patients suffering from anemia use the leaf juice to strengthen the blood. Other uses include: stems are macerated to produce fibres that are used as sponge; the oily seeds have lactating properties and are therefore in high demand by women with young babies; the raw flour shows better water- and fat adsorption properties than the oil, hence it is useful in baking and ground meat products; the rind and pulp of the fruit is used as fodder for livestock.

2.8 HEALTH BENEFITS OF FLUTED PUMPKIN

The sliced young leaves mixed with coconut water and salt could be stored in a bottle and used for the treatment of convulsion (Gbile, 1986). Also the leaf extract alone is useful in the management of hyperchelsterolaemia, liver problems, and impaired immune system (Eseyinet al., 2005a; Adaramoye, 2007) but the oil from the seed could result in hyperlipidermias and hyperglycaemia if consumed excessively. Protein Energy Malnutrition (PEM) is rarely seen among the dwellers where Telfairia is consumed in large proportion daily (Dike, 2010). The use of T. occidentalis in reproductive and fertility is gaining ground. Nwangwa et al. (2007) showed that it has potential to regenerate testicular damage and increase spermatogenesis.

Telfairia is high in anti- oxidant and free radical scavenger properties and that may contribute to why many use the leave extract in oxidative damage condition such as cancers, liver and liver diseases. In Nigeria the fresh leaves are ground and the juice used as tonic by women that have just given birth; its high iron content assists in the replenishment of lost blood; being used for treatment of anaemia, chronic fatigue and diabetes (Alada, 2010; Dina et al., 2006; Aderibigbe et al., 1999). The blood schizontocidal activity of the root of Telfairia is comparable to that of chloroquine (Okokon et al., 2007). The extract also shows inhibitory effect on growth of some bacteria (Oboh et al., 2006; Odoemena and Onyeneke 1998; Oluwole et al., 2003).

Telfairia roots are very poisonous because of their high sapoin content and are used to kill rats and mice as rodentcide and ordeal poison (Gill, 1992).

2.9 THE IMPORTANCE OF THE MINERAL ELEMENTS

The importance of mineral elements in human, animal and plant nutrition has been well recognized (Underwood, 1971; Darby, 1976). Deficiencies or disturbances in the nutrition of an animal cause a variety of diseases and can arise in several ways (Gordon, 1977). When a trace element is deficient, a characteristic syndrome is produced which reflects the specific functions of the nutrient in the metabolism of the animal. The trace elements are essential components of enzyme systems. Simple or conditioned deficiencies of mineral elements therefore have profound effects on metabolism and tissue structure. To assess the dietary intake and adequacy of minerals, information needs to be collected on mineral element content of foods, diets and water (Rao and Rao, 1981; Simsek and Aykut, 2007). There is limited information on the trace element content of water and numerous plant foods consumed in some less developed countries.

2.10 FUTURE RESEARCH NEEDS

Collection and identification of the various cultivars in the African continent is very essential; statistical data on total production in each country is inevitable; more information is needed on the uses of the crop in the traditional African societies, more study on the nutritive value of the leaves and seeds of different fluted pumpkin cultivars will be very useful; more research into the health benefits of the various parts of the crop is urgently needed especially the study of phytochemicals in fluted pumpkin (from the seedling to their consumption, passing though the harvesting, storage and processing etc) to have a better understanding of their mechanisms in human health.; breeding work on the crop is at its rudimentary stage and needs upgraded; improved planting materials are needed to increase its production. Collaborative research work between the Research Institutes and scientists working on the crop should be set up.

2.11 AIM AND OBJECTIVES

The main aim of this project is to determine the trace element constituent of *Telfaira occidentalis* (fluted pumpkin)

CHAPTER THREE

3.0 MATERIAL AND METHODS

3.1 Material

3.1.1 Collection of Sample

Samples of Telfairia occidentalis (fluted pumpkin) were collected from oke-ose in Ilorin, Kwara State. Sample was first washed with deionized water to remove adhering particles, The samples was dried at room temperature for five days. The dried samples were then ground to a fine powder using a laboratory mill and stored in airtight containers until analysis.

3.1.2 Apparatus Used

- 250 ml conical flasks
- Analytical balance
- Mechanical shaker (150 rpm)
- Filter paper (Whatman No. 1)

- Beakers
- Measuring cylinders
- Atomic Absorption Spectrophotometer (AAS) (Model AA990, PG Instrument Ltd, England)
- Drying oven
- Laboratory mill

3.1.3 Reagents Used

- Mehlich 3 Extracting Solution
- Deionized Water
- Standard Solutions for AAS Calibration
- Nitric Acid (HNO)
- Hydrochloric Acid (HCl)

3.2 Methods

3.2.1 Extraction of Sample

Exactly 2.0 grams of the dried and grounded Telfairia occidentalis sample were weighed into a 250 ml conical flask. A 20.0 ml volume of Mehlich 3 extracting solution was added to the flask. The mixture was then placed on a mechanical shaker set at 150 rpm and shaken continuously for 15 minutes. Upon completion, the mixture was filtered using Whatman No. 1 filter paper into clean, labeled beakers. The resulting filtrate was stored for mineral analysis.

This extraction method was chosen due to its proven effectiveness in releasing plant-available forms of trace elements from organic matrices, as recommended by AOAC (2019).

3.2.2 Mineral Analysis

The filtrate obtained from the extraction was analyzed for trace elements using an Atomic Absorption Spectrophotometer (AAS), Model AA990 by PG Instrument Ltd., England.

Calibration of the spectrophotometer was done using appropriate standard solutions for each element. Blank samples and standards were run prior to the analysis of each batch to ensure accuracy and precision. Each sample was analyzed in triplicate, and the average concentration was recorded. The instrument settings and lamp configurations were adjusted according to manufacturer specifications. The data obtained were reported in parts per million (ppm).

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Result

The table below summarizes the concentrations of trace elements determined in the Telfairia occidentalis sample:

Table 4.1.1: - Result of Trace element in Telfairia occidentalis

Elements	**Composition(ppm)**
Pb	0.30± 0.00
Cu	4.40±0.40
Ni	0.00±0.00
Mn	0.60±0.00
Zn	5.00±0.40

4.2 Discussion

Table 4.1.1 reveal the results of trace elements in Telfairia occidentalis. The concentration of Lead (Pb) was found to be lower, indicating safety from heavy metal contamination ,which is critical for public health. This is consistent with previous findings that Telfairia occidentalis tends to accumulate very low levels of lead unless grown in heavily contaminated soils

Copper (Cu), essential for red blood cell formation and enzyme function, was recorded at moderate levels of 4.40±0.40 ppm. These values fall within the acceptable dietary intake levels established by the WHO, suggesting that regular consumption of fluted pumpkin can contribute to copper requirements in the human diet without risk of toxicity.

Nickel (Ni) was not detected in the analyzed samples. its absence could indicate low soil availability or poor translocation in the plant under the studied environmental conditions. While manganese (0.60±0.00) is necessary for bone development and antioxidant enzyme activity, Further studies involving different growing conditions and broader sampling could help confirm this trend.

Zinc (Zn) was detected at 5.00±0.40 ppm in the samples, affirming the nutritional relevance of the plant. Zinc plays a critical role in immune function, cell division, and wound healing. The levels detected are consistent with other African indigenous vegetables, indicating that Telfairia occidentalis remains a reliable source of dietary zinc.

The results support the hypothesis that Telfaira occidentalis can serve as a functional food rich in micronutrients, especially in regions suffering from mineral deficiencies. The safe levels of toxic elements and appreciable concentrations of essential minerals further strengthen its use as a dietary supplement in both rural and urban diets.

These results underscore the nutritional value of Telfairia occidentalis, particularly as a source of bioavailable Zinc and Copper. Its absence of harmful heavy metals further makes it a safe and viable vegetable for regular consumption, particularly in regions where malnutrition and micronutrient deficiencies are prevalent. The study affirms the utility of indigenous vegetables in advancing food security and nutrition-sensitive agriculture.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion, the mineral profile obtained emphasizes the importance of promoting the cultivation and consumption of Telfairia occidentalis. Its potential to provide key trace elements makes it a sustainable candidate for nutrition-sensitive agriculture. Additional studies incorporating seasonal and varietal differences would help in expanding the applicability of these findings.

5.2 Recommendations

Government and health organizations should encourage the cultivation and consumption of Telfairia occidentalis due to its micronutrient benefits, especially in combating hidden hunger.

Further research should be conducted across different agro-ecological zones and growing seasons to assess variability in trace element content due to environmental and soil differences.

Investigating the effect of various organic and inorganic soil amendments on trace element uptake in Telfairia occidentalis could improve its nutritional profile.

Breeders and agricultural scientists should consider enhancing genetic lines of Telfairia occidentalis for improved trace element concentration and stress tolerance.

There should be increased awareness and education campaigns about the health benefits and culinary versatility of indigenous vegetables.

Government policies should prioritize the inclusion of indigenous vegetables in school feeding programs and public nutrition strategies.

With the advancements in the field of analytical sciences, involving the use of more sophisticated equipment for the quantitative and qualitative analysis of foods/feeds. There is need to re-visit the studies/investigations

/assessments /evaluations, so as to re-validate the data on the mineral elements composition of human and animal diets, especially in the developing countries. The earlier information on these mineral elements were based on analysis employing less sensitive methods which may not be reliable.

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