Nutritional and Anti-Nutritional Constituents of Cassava *(Manihot Esculentus)* Tubers and Leaves in Jos North Lga of Plateau State, Nigeria

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Abstract: **This study was conducted to determine the nutritional and anti-nutritional content of cassava tubers and leaves in Jos North Local Government Area of Plateau state, Nigeria. Proximate analysis was determined by standard method for the percentage moisture content, ash content, crude protein, crude fibre and carbohydrate. Elemental analysis was determined using AAS and UV-Spectrophotometer. The anti-nutritional constituents determined includes; cyanogenic glycosides, trypsin inhibitor, phytic acid, tannins and oxalate. The tubesr have moisture content (10.57±0.2%), ash content (2.4±0.001%), crude protein (4.8±0.30%), crude fat (2.4±0.02%), crude fibre (3.9±0.08%), carbohydrate (80.54±2.40%), calcium (29.31±0.14%), potassium (8.94±0.04%), sodium (38.7±0.20%), magnesium (23.5±0.10%), phosphorus (0.150±0.004%), cyanogenic glycosides (2.06±0.008mg/L), trypsin inhibitor (4.28±0.03TUI/mg), phytate (31.02±0.34mg/100g), tannins (3.64±0.009mg/100g), oxalate (1.29±0.029g/100g) and the leaves showed moisture content (5.86±0.01%), ash content (1.6±0.01%), crude protein (5.6±0.08%), crude fat(1.8±0.04%), crudefibre (4.6±0.01%), carbohydrate (75.9±0.60%), calcium (38.65±1.35%), Potassium (13.10±0.12%), sodium (58.8±0.58%), magnesium (24.80±0.20%), phosphorus (0.280±0.001%), cyanogenic glycosides (7.31±0.098mg/L), trypsin inhibitor (10.74±0.012TUI/mg), phytate (58.47±0.403mg/100g), tannins (78.67±0.471mg/100g), oxalate (1.61±0.084g/100g).**

***Key words*: Nutritional, Anti-nutritional, Cassava, Tuber, Leaves, Proximate Analysis.**

I. INTRODUCTION

Cassava (*Manihot esculentus)* is a perennial woody shrub with an edible root. It grows in tropical and subtropical regions and is known by different names in different parts of the world. (Adeyanju and Emesi,2019; Emesi *et al.*,2019). Cassava is a highly drought-tolerant crop with the ability to grow on marginal lands where cereals and other crops do not grow well. Cassava is the third largest source of food carbohydrates in the tropics, after rice and maize (Emesi *et al.*,2019).Food is made up of all nutrients which is needed for growth and maintenance of our body. A balanced diet supplies all nutrients in adequate amount to maintain optimal health. Anti-nutrients are natural or artificial compounds that interfere with the absorption of nutrients. Phytate and oxalates easily forms insoluble complexes with copper, iron and calcium. Tannins chelate metals and reduce the absorption of these nutrients. They also inhibit the action of digestive enzymes (Cock, 1985).

Like other roots and tubers, all varieties of cassava contain anti-nutritional factors and toxins (though in varying quantities), and must therefore undergo adequate processing and preparation before consumption. Poor processing and preparation can leave sufficient amount of residual cyanide to cause acute cyanide intoxication and goitres, and may even cause ataxia or partial paralysis. Cassava leaves are a significant source of potential alternative protein resource for both humans and animals (Fasuyi, 2005). The leaves, depending on the varieties, are rich in minerals, proteins, vitamin and carotenes (Adewusi and Bradbury, 1993). However, it also has some anti-nutritional and toxic substances.These substances interfere with digestibility and uptake of the nutrients, and they might present toxic effects depending on the amount consumed (Wobeto *et al.,* 2007).

In Nigeria, considerable amount of cassava leaves are generated annually and readily available as a by-product at the time of harvesting the roots. While cassava leaf protein is low in sulphur and amino acids, the content of most other essential amino acids is higher than in soya bean meal. The high protein content and a relatively good profile of essential amino acids are reasons for believing that cassava leaves could be a potential protein source for monogastric animals (Fasuyi, 2005).Therefore this research aim is to determine the mineral composition and the anti- mineral composition of manihot esculentus tubers and leaves.

II. MATERIALS AND METHODS

All the chemicals and solvents used in the experimental work were of analytical grade (AR) and all commercial solvent samples were purified by the method reported in the literature AOAC (2005).

Preparation of cassava tuber and leaves samples

The crude samples of cassava tuber and leaves consist of a mixture of large and small nodules mixed with bark and organic debris. These were hand sorted to remove fragments of bark and other visible impurities and then were spread out in the sun to dry for one to two weeks. The dried clean cassava tuber and leaves samples were milled with a kenwood blender (UK) and later sieved using a bin (mesh size- 250 microns) so as to obtain a fine and uniform sample kept in labelled container for subsequent analysis (Bultman, 1998).

Proximate Analysis

Proximate analysis was determined by standard method of AOAC (1980) and Adeyanju et al.,(2013) and Adeyanju et al., (2017) for the percentage moisture content, ash content, crude protein, crude fibre and carbohydrate.

Elemental determination of the ashed samples

ashed sample (0.5g) was weighed and transferred into the digestion tube. 5ml of each of distilled water, concentrated HNO_3 and $HClO_4$ were added and the content mixed. The tubes were placed on the digestion block inside a fume cupboard and the temperature control of the digester was set at 150ºC and digested for 90 minutes. The temperature was then increased to 230ºC and digested for another 30 minutes (white fuming stage). The digester temperature was reduced back to 150ºC, and followed by the addition of 1ml of hydrochloric acid to the tubes within a few minutes. The concentrated digest was not allowed to cool to room temperature to prevent formation of insoluble precipitate i.e. potassium perchlorate. More water was added to the tube to make up to mark and the content was mixed and filtered. The resulting solution was used for the elemental analysis using Atomic Absorption Spectrophotometer (AAS) with (A. Analyst 400 Model) and Flame photometer at an appropriate wavelength, temperature and lamp-current for the elements. The following elements were determined, calcium (Ca), magnesium (Mg), sodium (Na), and Potassium (K). (Adeyanju et al., 2012; Adeyanju and Joshua,2020)

Phosphorus (P) was determined by UV/Vis-Spectrophotometer.

Determination of the anti-nutritional composition of cassava tubers and leaves

Cyanogenic glycoside was determined using the alkaline picrate method of Oke (1969). Trysin inhibitor was determined using the method outlined by Markkar *et al.* (1993). Tannins was determined using the method described by Markkar *et al.* (1993). Oxalate was determined by using the same method.III. RESULTS

The results for the nutritional and anti-nutritional content of *Manihot esculentus* tuber and leaves are presented in tables 1 and 2

Table 1: Proximate composition of Manihot esculentus tubers and leaves

S/N	Nutritional Composition	Tuber	Leaves
1.	Moisture content (%)	10.57±0.2	5.86±0.01
2.	Ash content (%)	2.4±0.001	1.6±0.01
3.	Crude protein (%)	4.8±0.30	5.6±0.08
4.	Crude fat (%)	2.4±0.02	1.8±0.04
5.	Crude fibre (%)	3.9±0.08	4.6±0.01
6.	Carbohydrate (%)	80.54±2.40	75.9±0.60
7.	Calcium (mg/L)	29.31±0.14	38.65±1.35
8.	Potassium (mg/L)	8.94±0.04	13.10±0.12
9.	Sodium (mg/L)	38.7±0.20	58.8±0.58
10.	Magnesium (mg/L)	23.5±0.10	24.80±0.20
11.	Phosphorus (mg/L)	0.150±0.004	0.280±0.001

Results correct for triplicate analysis (mean ± S.D)

Table 2: Anti-nutritional composition of cassava tuber and leaves

S/N	Nutritional Composition	Tuber	Leaves
1.	Cyanogenic glycosides (mg/L)	2.06±0.008	7.31±0.098
2.	Trypsin inhibitor (TUI/mg)	4.28±0.03	10.74±0.012
3.	Phytate (mg/100g)	31.02±0.34	58.47±0.403
4.	Tannins (mg/100g)	3.64±0.009	78.67±0.471
5.	Oxalate (g/100g)	1.29±0.029	1.61±0.084

Result correct for triplicate analysis (mean ± S.D)

Note TUI= Trypsin Unit Inhibited, mg= milligram, g= gram and S.D= standard deviation

III. DISCUSSION

Manihot esculentus tubers showed higher moisture content (10.57±0.02%) than the leaves (5.86±0.01%). The samples contained 2.4±0.001% and 1.6±0.01% dry matter of ash for tuber and leaves respectively. The level of ash in the samples is appreciable and it's an indication of the potential usefulness of the tuber in ceramic and food processing. (Adeyanju and Emesi,2019). The crude protein content of the tubers and leaves samples were 4.8±0.30% and 5.6±0.08% respectively. This indicates possibility of its usage as a supplement of other protein sources in food.(Siddig,1996). Nitrogen and protein content of the two samples are in agreement with that reported for other polysaccharide (Siddig, 1996). Though the protein content in leaves was higher than that of the tuber, it shows that these samples could be used to provide protein supplement in both human and animal diets. The carbohydrate content of the *Manihot esculentus* tuber and leaves are 80.54±2.40% and 75.9±0.60% respectively. The tubers has higher carbohydrate content than the leaves. The samples are very rich in carbohydrate and this makes them recommendable for use in food industries. (Adeyanju and Emesi,2019). Carbohydrates are the most abundant class of inorganic compounds found in living matters. In plants and animals, it is one of the most consumed food stuffs. When metabolized, it provides about 4kcal of energy (Ene-Obong, 2001).Elemental analysis of *Manihot esculentus* tubers and leaves revealed that the samples are mainly composed of sodium (38.7±0.20 and 58.8±0.50mg/ L), calcium (29.31±0.14 and 38.665±1.35mg/ L), magnesium (23.51±0.10 and 24.80±0.20 mg/ L), potassium (8.94±0.04 and 13.10±0.12 mg/ L) and phosphorus (0.150±0.004 and 0.28±0.0008 mg/ L). These elements are essential in human and animal health. Magnesium and calcium are known to help in bone and teeth development. The tuber samples are found to have very high level of potassium, sodium and magnesium which are the essential minerals required by the body to meet metabolic needs. The anti-nutrient parameters were were higher in cassava leaves than in cassava tuber. The phytate and tannin contents in *Manihot esculentus* leaves were the highest, they are (58.47±0.403mg/100g) and 78.67±0.471mg/ 100g) respectively. The oxalate content for both tuber and leaves were very small. They are 1.29 ± 0.029g/100g and 1.61 ±0.084g/100g for the tuber and leaves respectively. Toxic substances can be reduced by cooking and fermentation.

IV. CONCLUSION

The nutritional and anti-nutritional constituent of *Manihot esculentus* tuber and leaves were analysed in this study. The maximum amounts of nutrients were observed in leaves when compared to the tuber. The cassava leaves showed high level of cyanogenic glycoside, tannins, phytate and oxalate which are all anti-nutrients. This shows that, the leaves can be a very good source of food, but proper pre-treatment must be carried out to reduce or remove the anti-nutrients if possible before consumption.

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