International Conference of Science, Engineering & Environmental Technology (ICONSEET), 2(27): 205-211, 2017
ISSN 0794-9650

www.repcomseet.com

Proximate, Minerals and Anti-Nutrient Evaluation of Cassava (*Manihot Esculenta* crantz) Leaves

Lawal, I. A., Ajayi, O. A. Owonibi, S. K. and Tajudeen Asimi.

Department of Science Laboratory Technology, The Federal Polytechnic, Ede, Osun State, Nigeria.

Abstract- ***As a compliment to the scientific efforts geared towards unravelling the nutritive usefulness of non-conventional leafy vegetables, leaves of Cassava (Manihot esculenta Crantz) harvested from a farm in Ede were subjected to standard methods of food analysis to determine the proximate composition, minerals and anti-nutritional contents with a view to encouraging its use as a leafy vegetable. The results show that the leaves on dry weight contained moisture content (51.6%), crude protein (13.98%), crude fat (0.92%), crude fiber (12.59%), ash (6.18%), energy value (345 kca/100g) and carbohydrate (68.83%). The elemental analysis of the leaves revealed the following in mg/100g; nitrogen (2.24), phosphorus (0.45), calcium (15.8), magnesium (53.4) and iron (47.8) while anti-nutritive content gave saponin (0.28), oxalate (0.61), cyanide (1.08) and phytate (0.78). The implication of this finding is that, the leaves can as well serve as leafy vegetables for man if because of its richness nutritionally and therefore its consumption should be made popular among people.***

Keyword: Proximate composition, minerals, anti-nutrient, cassava and dry weight.

1.0 Introduction

Cassava *(Manihot esculenta Crantz),* also called yuca or manioc**,** is a woody shrub of the Euphorbiaceae (spurge) family native to South America (Olsen *et al.*, 1999). According to the Food and Agricultural Organization of the United Nations (FAO) 1999, cassava is one of the most important food crops in Africa. It is also on record that Nigeria is the current world-leading producer of cassava (FAO, 2002). Hahn and Keyser (1985); Hahn *et al*. (1987) posited that cassava is an important staple food crops grown in tropical Africa and plays a significant role in efforts geared towards alleviating the African food crisis based on its efficient production of food energy, year-round availability, tolerance to extreme stress conditions, and suitability to present farming and food systems in Africa. It is also on record that Nigeria is the current world-leading producer of cassava (FAO, 2002).

Cassava shoots of 30 cm length (measured from the apex) are harvested from the plants. The hard petioles are removed and the blades and young petioles are pounded with a pestle in a mortar. A variation of this process involves blanching the leaves before pounding. The resulting pulp is then boded for about 30-60 minutes. In some countries, the first boiled water is decanted and replaced. Pepper, palm-oil and other aromatic ingredients are added. The mixture is then boiled for 30 minutes (Numfor and Ay 1987). Unlike the roots that are essentially carbohydrate, cassava leaves are a good source of protein and vitamins which can provide a valuable supplement to predominantly starchy diets.

Cassava leaves are rich in protein, calcium, iron and vitamins, comparing favourably with other green vegetables generally regarded as good protein sources. The amino acid composition of cassava leaves shows that, except for methionine, the essential amino acid values in cassava exceed those of the FAO reference protein (Lancaster and Brooks 1983). According to Yeoh and Chew (1976), the total essential amino acid content for cassava leaf protein is similar to that found in hen's egg and is greater than that in oat and rice grain, soybean seed, and spinach leaf. While the vitamin content of the leaves is high, the processing techniques for preparing the leaves for consumption can lead to huge losses. For example, the prolonged boiling involved in making African soups or stews, results in considerable loss of vitamin C (www.cassava.htm assessed on 6th June, 2017).

Cassava leaves had been reported to form a significant part of the diets in many countries in Africa. In fact, they are used as one of the preferred vegetables in most cassava growing countries, particularly in Zaire, Congo, Gabon, Central African Republic, Angola, Sierra Leone, and Liberia. The cassava leaves prepared as vegetable are called "sakasaka" or "pondu" in Zaire, Congo, Central African Republic and Sudan, "Kizaka" in Angola, "Mathapa" in Mozambique, "Chigwada" in Malawi, "Chombo" or "Ngwada" in Zambia, "Gweri" in Cameroon, "Kisanby" in Tanzania, "Cassada leaves" in Sierra Leone, "Banankou boulou nan" in Mali, "Mafe haako bantare" in Guinea, and "Isombe" in Rwanda. They are mostly served as a sauce which is eaten with chickwangue, fufu, and boiled cassava (www.cassava.htm accessed on 6th June, 2017). The potential yield of cassava leaves varies considerably, depending on cultivar, age of plant, plant density, soil fertility, harvesting frequency and climate Gomez and Valdivieso (1984). Despite the reported usage of the leaves of cassava leaves as green in some places its use is not yet popular among the people of this locality in particular hence, the need for this study with the following objectives.

i. to determine the proximate composition,
ii. to determine the mineral elements content; and
iii. To also determine the presence and concentration of anti-nutrients

2.0 Materials and Methods

Sample collection and treatment: Samples of *Manihot esculenta* leaves used in this study were collected from a farm in Ede, Osun state. Prior to the analysis, the leaves were destalked and washed and residual moisture allowed to evaporate at room temperature. Subsequently, the leaves were enveloped and oven dried at 60°C until constant weight was attained (Fasakin, 2004). The dried leaves were then ground into fine powder, sieved through 20 mesh sieves and stored in plastic containers for analysis. The experiments were replicated thrice for each of the analysis.

Proximate analysis (moisture, crude protein, ash content, crude fat, crude fibre and calorific value): The moisture content of the sample was determined by oven drying to a constant weight at 105°C in a GallenKamp oven (AOAC, 1990). Ash content was determined using dry ashing in Lenton Muffle Furnace at 525°C for 24hrs. The fat content was extracted with petroleum ether using a soxhlet apparatus and n- hexane as a solvent (AOAC, 1990). Crude protein content was calculated by multiplying the value obtained from Kjeldahl's nitrogen by a protein factor of 5.3, a factor recommended for vegetable analysis (Bernice and Merril, 1975). Crude fibre was estimated by acid-base digestion with 1.25% H2SO4 (w/v) and 1.25% NaOH (w/v) solutions (AOAC, 1999). The sample calorific value was e stimated (in kcal) according to the formula:

Energy = (g protein x 2.44) + (g lipid x 8.37) + (g available carbohydrate x 3.57) as reported by Asibey-Berko and Tayie (1999).

Determination of mineral contents:

Mixed acid digestion was carried out on 2 g each of the ground leave sample until a clear solution was obtained. The digest was allowed to cool and then transferred into a 20 ml standard flask and made up to mark with distilled water. Iron, zinc, Copper and manganese were determined using Atomic Absorption Spectrophotometer (AAS) Model 200, Germany (AOAC, 2005).

Determination of anti-nutrient content: Saponin was determined by the method described by Brunner (1984). Total oxalate was determined using the method described by (AOAC, 2005). Phytate was quantified using the method described by Ola and Oboh (2000).

3.0 Results and Discussion

The proximate composition of *Manihot esculenta* is presented in Table 1. The moisture content was found to be 51.6%, crude protein (13.98%), crude fat (9.21%), crude fiber (12.5%), ash (6.18%), carbohydrate (68.83%) and energy (345 kcal/100g). The moisture content of 51.6% reported in this leaves is very close to the value of 46.6 reported in the leaves of cassava (Etong *et al*., 2006) and higher than the values of 6.27-9.55 reported also in the cassava leaves (Oresegun *et al*., 2016). This value was however lower than the values of 70.5% and 72.83% reported in the leaves of *Ipomoea species* (Umar *et al*., 2007 and Olayiwola *et al*., 2009). The protein content of 13.98% was close to 14.41% reported in the leaves of cassava (Etong *et al*., 2006) and lower than the value of 18.74% found in the leaves of *Ipomoea batatas* (Lawal and Adeniyi, 2013).

The crude fat content was found to be 0.92% and this was lower than the values of 1.53% reported in the leaves of *Manihot esculenta* (Etong *et al*., 2006) but higher than 0.74% reported in the leaves of *Ipomoea batatas* (Asibey-Berko and Tayie, 1999). The sample crude fiber was found to be 12.5%. and this was higher than the value of 7.87% reported in the leaves of *Manihot esculenta* (Etong *et al*., 2006) and lower than the values of 15.86% and 17.67% found in the leaves of Ipomoea *species* (Lawal and Adeniyi, 2013 and Umar *et al*., 2007). Fiber is generally known to reduce the level of cholesterol in human blood and decreases the likelihood of different cancers (Mensah *et al*., 2008*)*. The ash content of 6.18% found in the sample was close to the finding of 6.22 and 6.27 found in the leaves of *Manihot esculenta* (Oresegun *et al*., 2016 and Etong *et al*., 2006). The high value of ash content indicates a high mineral content. High mineral elements in foods enhances growth and development and also catalyses metabolic processes in human body.

The energy value of 345 kcal/100g found in the sample is in contrast with the finding of Delvin (1982) who had reported that most vegetables have low calorific values of between 30 - 50 kcal/100g. This value was higher than the value of 300.94 kcal/100g found in the leaves of *Ipomoea aquatica* (Umar *et al*., 2007) and 288.3 kcal/100g in the leaves of *Ipomoea batatas* (Asibey-Berko and Tayie, 1999). It therefore shows that the sample is rich in energy.

Table 1: Proximate composition of *Manihot esculenta* leaves

Parameter	**Concentration (% Dry weight)**
Moisture content	51.60
Crude protein	13.98
Crude fat	9.21
Crude fibre	12.50
Total ash	6.18
Carbohydrate content	68.83
Caloric value (Kcal /100g)	345

Mineral Analysis

The result of mineral element composition is shown in Table 2. The presence of the elements investigated were established and that the elements differed in their concentrations as follows; Magnesium (Mg) 53.40 mg/100g, Iron (Fe) 47.80mg/100g, Nitrogen (N) 2.24mg/100g, Phosphorus (P) 0.45mg/100g and Calcium (Ca) 15.80mg/100g. The concentration is in the order; Mg > Fe > Ca > N > P. The outcome of this experiment is in agreement with the earlier findings that *Manihot esculenta* leaves contained appreciable amounts of nutritional elements (Etong *et al*., 2006; Oresegun *et al*., 2016 and www. healthbenefitstimes.com/cassava-leaf assessed on 20th August, 2017). The values do not however correspond with the values reported by Frederick (2008). However it had been established by Oresegun (2016) that concentrations of elements varies among different varieties of *Manihot esculenta* . The concentrations of the elements in the leaves of *Manihot esculenta* are lower than the values reported in the leaves of *Xanthosoma sagittifolium* except in Iron (Fe) (Lawal and Ajayi, (2016). Iron (Fe) concentration of 47.80 mg/100g recorded in this sample is higher than the value of 36.69-147.87mg/100g reported in the leaves of *Ipomoea batatas* (Asibey-Berko and Taiye, 1999). Looking at the most important major mineral elements (Calcium and Phosphorus), high calcium with corresponding low Phosphorus in the leaves with Ca/P ratio 35.11 shows the disproportionate distribution of the Calcium and Phosphorus. This may affect their utilization for ideal growth and bone formation (Balogun and Fatuga,1986).

Table 2: Mineral elements composition of *Manihot esculenta* leaves

Mineral element	Concentration (mg/100g)
Fe	47.80
Mg	53.40
Ca	15.8
N	2.24

Anti-nutrient Composition

The result of anti-nutrient composition is presented in Table 3. The presence and concentrations of the anti-nutrients are; cyanide 1.08mg/100g, saponin 0.28mg/100g, oxalate 0.61mg/100g and phytate 0.78mg/100g. Cyanide has the highest value while saponin has the least value. Their concentrations were generally low when compared with the values reported by Etong *et al*., (2006) but similar to the values reported in the leaves of *Manihot esculenta* by Oresegun, *et al*., (2016) and leaves of *Ipomoea batatas* Lawal and Adeniyi, (2013). The presence of these anti-nutrients in food are known to be beneficial to the body due to the fact that they contain anti-oxidants (Vucenik and Shamsuddin, 2003). The cyanide concentration of 1.08 mg/100g can thus be classified as nontoxic because it fell below 10mg/100g powder according to Ikediobi *et al*., (1980). The lethal dose (LD) of cyanide oscillates from 0.5-3.5mg/kg human body weight Wogan and Marletta, (1993). However, it has been reported by Osuntokun (1981) that the chronic toxicity of cyanide is due to the consumption of its lower doses over a longer period.

Table 3: Anti -nutrient composition of *Manihot esculenta* leaves

Parameters	Concentration (Mg/100g)
Saponin	0.28 Z
Phytate	0.78
Oxalate	0.61

4.0 Conclusion

Casava (*Manihot esculentus*) leaves from the analysis carried can be said to possess high potential for its use as a leafy vegetable because it contains appreciable amounts of nutritionally required ingredients. Apart from been cheap, it is also readily available. People should therefore be sensitized about the usability of cassava leaves as a leafy vegetable. This will also go a long way to solve food crisis facing mankind most especially Nigerians.

References

[1] AOAC, (1990). Official Methods of Analysis, Association of Official Analytical Chemist AOAC, Washington,

[2] AOAC, (1999). Official Methods of Analysis, Associaltion of Official Analytical Chemist AOAC, Washginton.

[3] AOAC, (2005). Official Methods of Analysis, Associaltion of Official Analytical Chemist AOAC, Washginton.

[4] Asibey - Berko, E and Tayie, F. A. K. (1999). Proximate analysis of some underutilized Ghanaian Vegetables. *Ghana Journal of Science*, 39: 91-92.

[5] Balogun, A. M. and Fatuga, B. L. (1986). Chemical composition of some unexploited leguminous crop seeds in Nigeria. *Journal of Agric. and Food Chem*. 34: 189-192

[6] Bernice, K. W. and Merril, A. L. (1975). Handbook of the Nutritional Contents of Foods US Department of Agriculture, New York. Dover Publishers Inc.

[7] Brunner, J. F. (1984). Direct Spectrophotometric determination of saponnin. *Analytical Chemistry*. 34: 131-136.

[8] Etong, D. J., Mustapha, A. O. and Lawrence, I. G. (2006). Proximate, minerals and anti- nutritional assessment of cassava (*Manihot esculenta*) leaves. *International Journal of Chem. Science*. 7 (1): 26-32.

[9] FAO (1999). Worldbook. food and agricultural organization of the united nations. Rome.

[10] Fasakin, K. (2004) Proximate composition of Bungu (*Ceratotheca sesamoides* Endl) leaves and seeds Biokemistri, 16:88-92.

[11] Frederick, D. O. (2008). *Hog and hominy: Soul food from Africa to America* (pp. 1-2:1- 24). New York, NY: Columbia University Press.

[12] Gomez, G. and Valdivieso, M. (1984). Casava for animal feeding: Effect of variety and plant age on production of leaves and roots. *Animal Feed Science and Tech.* 11: 49-55

[13] Hahn, S.K, and J. Keyser. 1985. Cassava: a basic food of Africa. Outlook on Agriculture 4: 95-100.

[14] Hahn, S.K., N.M. Mahungu, J.A Otoo, M.A M. Msabaha, N.B. Lutaladio, and M.T. Dahniya. 1987. Cassava end African food crisis. Pages 24-29 in Tropical root crops -root crops and the African food crisis. Proceedings, Third Triennial Symposium of the International Society for tropical Root Crops - Africa Branch, edited by E.R Terry, M. Akoroda, and O. B. Arene, 17-23 August 1986, Owerri, Nigeria.

[15] Ikediobi, C. O., Onyia, G. O. C., & Eluwah, C. E. (1980). A rapid and inexpensive enzymatic assay for total cyanide in cassava (*Manihot esculenta,* Crantz) and cassava products. *Agricultural and Biological Chemistry, 44*, 2803–2809.

[16] Lancaster, P.A., and J.E. Brooks. 1983. Cassava leaves as human food. Economic Botany 37(3): 331 -34

[17] Lawal, I. A. and Adeniyi, B. O. (2013). Proximate, minerals and anti-nutrient composition of the leaves of sweet potato (*Ipomoea batatas*). *Journal of Science Technology Research,* 12(2): 54 - 58.

[18] Mensah, J.K., Okoli, R. L., Ohaju-Obodo, J. O. and Elfediyi, K. (2008). Phytochemica,l nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria. *African Journal of Biotechnology*, 7 (14): 2304-2309.

[19] Ola, F. L and Oboh, G. (2000). Nutritional evaluation of *Cassia siamea* leaves. *Journal Technosci*, 4:1-3.

[20] Olsen, K. M. and Scholar, B.A. (1999). Evidence on the origin of cassava: phylogeography of *Mani hot esculenta* . Retrieved on June 12, 2010 from http:// www.pnas.org /content /96/10/5586. Abstract.

[21] Oresegun, A., Fagbemiro, O. A., Ilona, P. and Edah, B. (2016). Nutritional and anti-nutritional composition of cassava leaf protein concentrate from six cassava varieties for use in aqua feed. *Journal of Cogent Food and Agriculture* Vol.2 Issue 1, pp 269-276

[22] Osuntokun, B. O. (1981). Cassava diet, chronic cyanide intoxication and neuropathy in Nigerian Africans. *World Review of Nutrition and Dietetics, 36*, 141–173Z

[23] Numfor, F.A., and P. Ay. 1987. Postharvest technologies of root and tuber crops in Cameroon: a survey. Memoires et travaux de l'IRA, Cameroon. 54 pp.

[24] Wogan, G. N., & Marletta, M. A. (1993). Componentes perjudiciales o potencialmente perjudiciales de los alimentos. In O. R. Fennema, Química de los alimentos, (2nd ed., pp. 775–811). Zaragoza: Acribia.

[25] Yeoh, H.H., and M.Y. Chew. 1976. Protein content and amino acid composition of cassava leaf. Phytochemistry 15: 1597-1599.