Research Journal of Botany

ISSN 1816-4919

Academic Journals Inc.

www.academicjournals.com

OPEN ACCESS Research Journal of Botany

ISSN 1816-4919
DOI: 10.3923/rjb.2020.1.5

Research Article
Comparative Studies of Four Varieties of *Manihot esculenta* Crantz

Okonwu Kalu and Eyaba Mary Agara

Department of Plant Science and Biotechnology, University of Port Harcourt, P.M.B. 5323, Port Harcourt, Nigeria

Abstract

Background and Objective: Cassava products available in market for human consumption are from different cassava varieties. The study evaluated and compared some of the morphological and biochemical indices in 4 varieties of cassava (*Manihot esculenta*). **Materials and Methods:** The morphological parameters assessed were number of nodes, internodes, petiole length, stem length, stem color, leaf color and nature of branching per plant, while the biochemical indices were chlorophyll content of the leaves, hydrogen cyanide and proximate composition of the roots. Four varieties of cassava used were TMS 96/0603, TMS 92/0326, TMS 30572 and Umucass 44. Standard procedures were followed in the morphological and biochemical assessments. **Results:** The study showed morphological and biochemical differences among the four cassava varieties. Umucass 44 variety had the highest number of nodes with the lowest value for leaf petiole length compared to others. The early-branching and highest stem-length were observed in TMS 96/0603 variety, while others showed late-branching. The varieties with light-green pigmentation had the highest total chlorophyll content (TMS 92/0326>Umucass 44) followed by greenish-purple (TMS 30572) and dark-green (TMS 96/0603). The chlorophyll b of TMS 92/0326 variety was significantly different from the chlorophyll b of other varieties. TMS 92/0326 variety had the highest hydrogen cyanide content compared to other varieties. Crude fibre content was higher than the carbohydrate content in Umucass 44 variety, but the reverse was the case for other varieties. **Conclusion:** The study suggests the consumption of Umucass 44, TMS 96/0603 and TMS 30572 varieties based on the low cyanide content.

Key words: Pigmentation, morphological differences, nutritional composition, cassava varieties

Citation: Okonwu Kalu and Eyaba Mary Agara, 2020. Comparative studies of 4 varieties of *Manihot esculenta* Crantz,. Res. J. Bot., 15: 1-5.

Corresponding Author: Okonwu Kalu, Department of Plant Science and Biotechnology, University of Port Harcourt, P.M.B. 5323, Port Harcourt, Nigeria

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Manihot esculenta Crantz belongs to Euphorbiaceae family, commonly known as cassava, is a woody shrub[1]. According to Henry[2], it is majorly cultivated as an annual crop for its edible starchy tuberous roots in the tropical and subtropical regions of the world. Ukpabi[3] reported that *M. esculenta* was highly ranked among crops that convert light energy into chemical energy (carbohydrate) per unit geographic area. However, this starchy tuberous root contains cyanogenic glycosides and other nutritional content such as; protein, fibre, ash and lipid. It was earlier reported by IITA[4] that *M. esculenta* serves as basic diet for millions of people, especially Nigerian. Also, *M. esculenta* supply high yields of energy per unit area compared to *Zea mays* and plays a crucial role in food security, serves as a cash crop[5,6]. *Manihot esculenta* has been used to make variety of products like; chips, fufu, garri, starch flour, ethanol, biofuel, medicinal products and feed for livestock[7]. Africa currently accounts for more than 50% of the world's annual output of 184 million Mt in 2002, rising to 230 million Mt in 2008 with Nigeria being the leading producer[8]. This rise in production in Nigeria was as a result of improved *M. esculenta* varieties that have high yielding capacity, pest and disease resistance[9]. Although, this increase in production is considered low compared to the population dynamics of Nigeria, which is on the increase continuously. According to Aerni[10], most subsistence farmers have continued to use local cultivars which has resulted in low yields due to insufficient supply of good planting materials. Eze and Ugwuoke[11] reported that cassava tuber yield is influenced by both the quality of planting material used and the agronomic practices employed.

Sequel to the role of *M. esculenta* in the food-web, mostly in Nigeria, the study evaluated, compared some of the morphological characteristics and biochemical indices of 4 cassava varieties (TMS 96/0603, TMS 92/0326, TMS 30572 and Umucass 44) cultivated and consumed in Port Harcourt, Nigeria.

MATERIALS AND METHODS

The four varieties of cassava (TMS 96/0603, TMS 92/0326, TMS 30572 and Umucass 44) used were obtained from the Agricultural Development Programme (ADP), Port Harcourt, Nigeria. The study was carried out at school-to-land farm under ADP in the year 2017. The study compared some of the morphological features and biochemical compositions of these cassava varieties. The morphological parameters assessed were number of nodes, internodes, petiole length, stem length, nature of branching, stem color and leaf color while the biochemical indices assessed were chlorophyll content, hydrogen cyanide and proximate composition (crude protein, carbohydrate, moisture, ash, crude fibre and crude lipid).

The number of nodes of the cassava varieties were determined by direct counting, while nature of branching, stem color and leaf color were by visual observation. Also, internodes, petiole length and stem length were measured by using meter rule. For some of the biochemical indices, the chlorophyll contents were obtained following standard method[12-14], while AOAC[15] was used to determine the proximate composition of these cassava varieties. The hydrogen cyanide of the cassava varieties was determined according to method earlier used by Onwuka[16].

Statistical analysis: Data of all observations were analyzed as Means±Standard deviation subjected to one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Morphological characters and chlorophyll content: The morphological characters assessed among the four cassava plant varieties and the chlorophyll content of the leaves are presented in Table 1 and 2, respectively. There are obvious morphological differences among the varieties; Umucass 44 variety had the highest number of nodes with the lowest

Table 1: Morphological variation of 4 varieties of cassava

	Cassava variety			
Parameters	TMS 96/0603	TMS 92/0326	TMS 30572	Umucass 44
Time of planting	12/10/2017	12/10/2017	7/10/2017	12/10/2017
Number of nodes	40.00±10.00	38.00±8.73	37.00±00.70	46.00±2.12
Internodes (cm)	30.15±00.72	3.050±1.64	30.08±00.99	30.28±1.32
Petiole length (cm)	16.96±60.17	28.50±5.58	27.90±50.57	11.05±5.11
Stem length (cm)	75.66±30.60	69.66±4.04	55.00±40.24	66.50±2.12
Leaf color	Dark green	Light green	Greenish-purple	Light green
Stem color	Dark brown	Brown	Light green	Grey
Nature of branching	Early-branching	Late-branching	Late-branching	Late-branching

Mean±Standard deviation

Table 2: Chlorophyll content (mg g^{-1}) of 4 varieties of cassava

	Chlorophyll		
Cassava variety	a	b	Total chlorophyll
TMS 96/0603	47.09±1.54	28.61±1.17	75.70±2.48
TMS 92/0326	54.40±1.47	42.29±2.06	96.49±3.71
TMS 30572	46.74±2.24	29.04±1.78	75.76±4.01
Umucass 44	47.43±2.00	28.39±1.65	76.19±3.36

Mean±Standard deviation

Table 3: Proximate nutritional and hydrogen cyanide composition of 4 varieties of cassava

	Cassava variety			
Composition	TMS 96/0603	TMS 92/0326	TMS 30572	Umucass 44
Crude protein (%)	2.190	1.750	2.630	2.630
Carbohydrate (%)	32.91	27.13	26.49	16.67
Moisture (%)	47.82	61.71	50.96	55.74
Ash (%)	0.530	0.085	0.520	0.050
Crude fibre (%)	15.65	8.105	18.64	23.99
Crude lipid (%)	0.900	1.220	0.760	0.920
Hydrogen cyanide (mg kg^{-1})	65.00	140.00	55.00	50.00

value for leaf petiole length compared to others (TMS 96/0603, TMS 92/0326 and TMS 30572). The presence of more nodes suggested that a short-stem length could be used during vegetative propagation than long stem length with minimal number of nodes. The early-branching was observed in TMS 96/0603 variety, while others (TMS 92/0326, TMS 30572 and Umucass 44) showed late-branching and this early-branching could be the reason for the highest stem-length recorded in TMS 96/0603.

It was observed that the varieties with light-green pigmentation had the highest total chlorophyll content (TMS 92/0326>Umucass 44) followed by greenish-purple (TMS 30572) and dark-green (TMS 96/0603). The chlorophyll b of TMS 92/0326 variety was significantly different from the chlorophyll b of other varieties (TMS 96/0603, TMS 30572 and Umucass 44). The ratio of chlorophyll a to chlorophyll b is approximately 1:1 in TMS 92/0326, while others (TMS 96/0603, TMS 30572 and Umucass 44) had a ratio of 1:2. Kim *et al.*[17] documented that specific wavelengths of light like blue-light are crucial in plant physiological processes like germination, stem growth and biomass accumulation. Also, Samuoliene *et al.*[18] reported the vital role of blue-light in chlorophyll biosynthesis and chloroplast maturation, stomatal opening and enzyme synthesis photosynthesis processes.

Proximate nutritional and hydrogen cyanide composition: The nutritional composition and hydrogen cyanide content among the four cassava varieties varied (Table 3). This observation is in line with the work of Chavez *et al.*[19], who documented that there is difference in the nutritive value of *M. esculenta* roots. Crude fibre content was higher than the carbohydrate content in Umucass 44 variety, but the reverse was the case for TMS 96/0603, TMS 92/0326 and TMS 30572 varieties. Across the varieties, higher percentage moisture content showed lower percentage ash content. Also, crude protein was low compared to carbohydrate among the 4 varieties. However, the carbohydrate content of the 4 *M. esculenta* varieties were lower compared to the work of Adepoju and Nwangwu[20] on cassava. The percentage crude protein of the four varieties are within the range (1.2-3.5%) as reported by Emmanuel *et al.*[21], who investigated 6 cassava varieties. The value of hydrogen cyanide in TMS 92/0326 variety was twice compared to other varieties (TMS 96/0603, TMS 30572 and Umucass 44). According to Aregheore and Agunbiade[22], *M. esculenta* that grows in drought condition usually has high cyanide toxins. Wilson and Dufour[23] documented that low cyanide from sweet *M. esculenta* has <50 ppm cyanogenic equivalents while high cyanide from bitter *M. esculenta* has >100 ppm cyanogenic equivalent. Most bitter *M. esculenta* varieties are tolerant to drought, readily available in the market place and a lot cheaper in price value[24]. *Manihot esculenta* intake with high cyanide content may amount to food poisoning, which results in death[25].

CONCLUSION

Manihot esculenta varieties differ in their morphological and biochemical compositions. Umucass 44 variety had the highest number of nodes with the lowest value for leaf petiole length compared to others (TMS 96/0603, TMS 92/0326 and TMS 30572). The early-branching was observed in TMS 96/0603 variety with the highest stem-length while others

(TMS 92/0326, TMS 30572 and Umucass 44) showed late-branching. It was observed that the varieties with light-green pigmentation had the highest total chlorophyll content compared to dark-green pigmentation in the leaves. The hydrogen cyanide content in TMS 92/0326 variety was twice compared to other varieties (TMS 96/0603, TMS 30572 and Umucass 44). Crude fibre content was higher than the carbohydrate content in Umucass 44 variety, but the reverse was the case for TMS 96/0603, TMS 92/0326 and TMS 30572 varieties. Across the varieties, higher percentage moisture content showed lower percentage ash content. These variations in varieties confers their adaptability to various agro-ecological zones which is important for plant breeding program. This promote the capability of local farmers in selecting good and quality planting materials to enhance productivity and profitability of crop market value.

SIGNIFICANCE STATEMENT

This study showed that the ratio of chlorophyll a and b in TMS 92/0326 variety is 1:1 with high total chlorophyll content, even when the plant had late-branching. Also, the hydrogen cyanide content was high when compared with other varieties (TMS 96/0603, TMS 30572 and Umucass 44). The study provides information on the nutritional composition of the 4 cassava varieties which guides the consumption and avert health challenges in humans.

REFERENCES

1. Gill, L.C., 1988. Taxonomy of Flowering Plants. African Fed Publishers Ltd., Onitsha, Nigeria, pp: 163.
2. Henry, C., 2006. Cassava improvement in sub-saharan Africa and North Eastern Brazil. Proceedings of the 1st International Meeting on Cassava Breeding, Biotechnology and Ecology, November 11-15, 2006, University of Brasilia, pp: 102-108.
3. Ukpabi, U.J., 2009. Cassava Processing and Utilization: A Sensitization Book. 1st Edn., NCCRI., Umudike, Nigeria.
4. IITA., 1990. Cassava in Tropical Africa: A Reference Manual. International Institute of Tropical Agriculture, Ibadan, Nigeria, ISBN-13: 9789781310416, Pages: 176.
5. Achinewhu, S.C. and C.I. Owuamanam, 2001. Garification of five improved cassava cultivars, physicochemical and sensory properties of gari yield. Afr. J. Root Tuber Crops, 4: 18-21.
6. Bassey, E.E. and G.I. Harry, 2013. Screening cassava (*Manihot esculenta* Crantz) genotypes for tuber bulking, early maturity and optimum harvesting time in Uyo, South Eastern Nigeria. Peak J. Agric. Sci., 1: 83-88.
7. Abeygunasekera, A.M. and K.H. Palliyaguruge, 2013. Does cassava help to control prostate cancer? A case report. J. Pharm. Technol. Drug Res., Vol. 2, No. 1. 10.7243/2050-120X-2-3
8. Njoku, D.N., C.N. Egesi, I. Asante, S.K. Offei and G. Vernon, 2009. Breeding for improved micronutrient cassava in Nigeria: Importance, constraints and prospects. Proceedings of the 43rd Annual Conference of the Agricultural Society of Nigeria, October 20-23, 2009, The National Universities Commission Auditorium and RMRDC., Abuja, Nigeria, pp: 210-214.
9. Ezulike, T.O., K.I. Nwosu and O.N. Eke-Okoro, 2013. A guide to cassava production in Nigeria. Extension Guide No. 16, National Root Crops Research Institute, Umudike, Nigeria, pp: 1-10.
10. Aerni, P., 2006. Mobilizing science and technology for development: The case of the Cassava Biotechnology Network (CBN). AgBioForum, 9: 1-14.
11. Eze, S.C. and K.I. Ugwuoke, 2009. Evaluation of different portions of cassava (*Manihot esculenta*) in the management of its establishment and yield. Proceedings of the 143rd Annual Conference of Agricultural Society of Nigeria, October 20-23, 2009, The National Universities Commission/RMRDC., Abuja, pp: 120-123.
12. Kukrić, Z.Z., L.N. Topalić-Trivunović, B.M. Kukavica, S.B. Matoš, S.S. Pavičić, M.M. Boroja and A.V. Savić, 2012. Characterization of antioxidant and antimicrobial activities of nettle leaves (*Urtica dioica* L.). Acta Periodica Technol., 43: 257-272.
13. Chang, S.K., N.K. Prasad and I. Amin, 2013. Carotenoids retention in leafy vegetables based on cooking methods. Int. Food Res. J., 20: 457-465.
14. Duma, M., I. Alsina, S. Zeipina, L. Lepse and L. Dubova, 2014. Leaf vegetables as source of phytochemicals. Proceedings of the 9th Baltic Conference on Food Science and Technology "Food for Consumer Well-Being", (FOODBALT 2014), Latvia University of Agriculture Faculty of Food Technology, pp: 262-265.
15. AOAC., 1990. Official Methods of Analysis. 14th Edn., Association of Official Analytical Chemist, Arlington, VA., USA., pp: 503-515.
16. Onwuka, G.I., 2005. Food Analysis and Instrumentation: Theory and Practice. Naphtali Prints, Lagos, Nigeria, pp: 122-128.
17. Kim, H.H., G.D. Goins, R.M. Wheeler and J.C. Sager, 2004. Green-light supplementation for enhanced lettuce growth under red-and blue-light-emitting diodes. HortScience, 39: 1617-1622.
18. Samuoliene, G., A. Brazaitype, A. Urbonaviculte, G. Sebajeviene and P. Duchoviskis, 2010. The effect of red and blue light component on the growth and development of frigo strawberries. Zemdirbyste-Agric., 97: 99-104.
19. Chavez, A.L., T. Sanchez, G. Jaramillo, J.M. Bedoya and J. Echeverry *et al*., 2005. Variation of quality traits in cassava roots evaluated in landraces and improved clones. Euphytica, 143: 125-133.
20. Adepoju, O.T. and J.O. Nwangwu, 2010. Nutrient composition and contribution of noodles (Abacha) and local salad from cassava (*Manihot* spp.) to nutrient intake of Nigerian consumers. Afr. J. Food Sci., 4: 422-426.

21. Emmanuel, O.A., A. Clement, S.B. Agnes, L. Chiwona-Karltun and B.N. Drinah, 2012. Chemical composition and cyanogenic potential of traditional and high yielding CMD resistant cassava (*Manihot esculenta* Crantz) varieties. Int. Food Res. J., 19: 175-181.
22. Aregheore, E.M. and O.O. Agunbiade, 1991. The Toxic effects of cassava (*Manihot esculenta* Grantz) diets on humans: A review. Vet. Hum. Toxicol., 33: 274-275.
23. Wilson, W.M. and D.L. Dufour, 2002. Why "bitter" cassava? Productivity of "bitter" and "sweet" cassava in a Tukanoan Indian settlement in the Northwest Amazon. Econ. Bot., 56: 49-57.
24. Akintonwa, A. and O.L. Tunwashe, 1992. Fatal cyanide poisoning from cassava-based meal. Hum. Exp. Toxicol., 11: 47-49.
25. Akintonwa, A., O. Tunwashe and A. Onifade, 1994. Fatal and non-fatal acute poisoning attributed to cassava-based meal. Acta Hortic., 375: 285-288.