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Amino Acid Composition of *Dioscorea dumetorum* Varieties

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Abstract: The crude protein contents and amino acid compositions of two varieties of *Dioscorea dumetorum* (edible and wild) were determined. The crude protein (g/100g) of the wild variety (11.37) was significantly higher ($P < 0.05$) than the edible variety (7.0). The amino acid profiles showed both varieties to be limiting in lysine, methionine and cystine. The wild variety had tryptophan (0.60g/100g total aa), phenylalanine (3.01g/100g total aa), threonine (2.93g/100g total aa) and valine (3.6g/100g total aa) in substantial amounts when compared to the reference FAO pattern. Aspartic acid (4.47-9.28/100g total aa) was the most abundant amino acid in both varieties with the highest amount recorded for the wild variety. The chemical scores of the essential amino acids were tryptophan (60.0), threonine (43.5), valine (39.6), methionine (28.0) isoleucine (34.5), leucine (32.0), tyrosine and phenylalanine (39.0) and lysine (20.72) for the edible and tryptophan (117.0), threonine (73.25), valine (72.0), methionine (54.0) isoleucine (64.75), leucine (65.71), tyrosine and phenylalanine (83.67) and lysine (44.18) for the for the wild variety. This results being the first amino acid profiles recorded for this yam suggests that the wild *D. dumetorum* is richer in amino acid content than the edible variety and is likely to be of more benefit in human and animal nutrition.

Key words: *Dioscorea dumetorum*, amino acid, compositions, wild, edible, varieties, nutrition and chemical scores

Introduction

Yam is one of the staple foods in Nigeria and other tropical African countries. There are however, several varieties of yam. The *Dioscorea dumetorum* varieties are of importance in a growing economy such as the Nigerians economy. Generally, yams play significant role in the diets of most Africans, the Caribbeans and South Pacific, where it has been reported to represent 12% of the feeding (Malaurie, 1998). *Dioscorea dumetorum* is one of the first four varieties of yam that are indigenous to Africa and probably Nigeria (Coursey, 1967; Okonkwo, 1985; Martins and Ruberte, 1975; Onwueme, 1978; FAO / WHO / UNU, 1985). Starch obtained from *D. dumetorum* has been reported to be as digestible as cornstarch (Delpuch and Favier, 1980). This is because of its tiny polygonal or spherical granules with a type A X-ray diffraction structure that is similar to that of cereals (Robin, 1976).

In order to meet the escalating need for energy and protein in developing countries, considerable attention is focused on foodstuff with low concentration of proteins because of the critical role they play when used as dietary staples. Yams have been reported to provide more protein per hectare per year than maize, rice and soybeans, in spite of their low protein content (Idusogie, 1971). In Nigeria, there are many foodstuffs, which make up part of the traditional food system but their economic and nutritional values have not been well explored. Such is the case with *Dioscorea dumetorum* especially the wild variety that is eaten only in times of food scarcity.

The tubers of both the edible and wild *Dioscorea dumetorum* are processed by boiling and in the case of the wild variety, sliced, tied in a jute sack and left in a running water for 3 days to remove poisonous and / or bitter compounds that are believed to be injurious to health.

In spite of the available reports on the high protein content of *D. dumetorum*, especially the cultivated one (Agbor and Treche, 1983) and the high consumption of this yam, there is little or no information on the amino acid composition of the *D. dumetorum* protein. But we do know that the amino acid analysis of foodstuff is an important index of its food quality and can elucidate useful information on the nutritional quality and authenticity of food products and sources of raw materials used in food manufacture. For one to stimulate the consumption and mass production of the two varieties of the *D. dumetorum* as has been done to cassava in Nigeria, there is therefore, the need for research on their amino acid contents. In this study, two varieties of the *D. dumetorum* (the edible and wild varieties) were analyzed to determine the levels of essential and non-essential amino acid hence, their nutritional qualities. The results of this investigation will be useful information to the nutritionists and chemists who are constantly in search of additional food sources and products for both human and animal consumptions.

Materials and Methods

The tubers of the cultivated *Dioscorea dumetorum* were obtained from specific farmers in Ikot Akpanabia, Nsit

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Table 1: Crude protein contents of *Dioscorea dumetorum* varieties

	Edible <i>D. dumetorum</i>	Edible <i>D. dumetorum</i>
Crude Protein (NX6.25)	7.0±0.33 ^a	11.37±0.18 ^b

a, b values with no common superscript are significantly different (P < 0.05).

Ubium Local Government area of Akwa Ibom State of Nigeria while the wild variety were obtained from a forest of the same locality. The samples were representative of the varieties in the area. The tubers were washed, air dried; the fibrous roots removed and the tuber weighed to obtain fresh weight. Tubers were processed within four hours of harvest by drying in an air draught oven at 40°C for 6 hours, ground to fine powder and stored in air tight containers. Triplicate analyses were done on each variety that has been bulked together and treated as a single sample.

Chemical analysis: The method of AOAC was adopted for determination of crude protein and amino acids content of the samples (A.O.A.C. Official Methods of Analysis, 2000). The samples were hydrolyzed with 6N HCl at 110°C in vacuum for 24 hours. Hydrolysates were analyzed for amino acids by ion exchange HPLC using ninhydrin post column derivation. In the determination of sulphur amino acids, the samples were first oxidized using per formic acid hydrolysis, followed by acid hydrolysis and quantified by cation exchange chromatography using fluorescence detection. Tryptophan was determined after alkali hydrolysis using reverse phase chromatographic technique and the absorbance read with a UV detector. The quality of protein was evaluated chemically using values of amino acids obtained and those of FAO reference pattern to determine the chemical score (FAO/WHO, 1973). Data

were presented as mean ± SD of triplicate analysis for each sample, standard student's t-test was used for statistical analysis and P≤0.05 was considered as significant.

Results and Discussion

The crude protein contents of the wild and edible varieties of *Dioscorea dumetorum* are given in Table 1. The wild variety had a significantly higher protein content (11.37g/100g) than the edible variety (7.0g/100g). The amino acid composition of the varieties is summarized in Table 2. The results show that lysine was the most limiting amino acid followed by cystine and methionine (the sulphur containing amino acids), in both varieties which agreed with the report of Osagie (Osagie, 1992) for other yam proteins. The wild variety had the essential amino acids: tryptophan, phenylalanine, threonine and valine in levels that compared favourably with the FAO/WHO provisional pattern (FAO/WHO, 1973). Values obtained for amino acids of edible *D. dumetorum* compared favourably with the report of Oyenuga (Oyenuga, 1968).

The levels of arginine and histidine, for both varieties especially the wild (749mg/N arginine: 214mg/N histidine) were higher than levels of these amino acids in most common foods especially cereals such as maize (300mg/N and 156mg/N for arginine and histidine respectively) and rice (450mg/N and 106mg/N for arginine and histidine respectively) which are used for formulation of weaning formulae where these amino acids are essential for growth (Ihekeronye and Ngoddy, 1985.). In addition, the lysine level of the wild variety (388mg/N) is higher than that of rice (200mg/N) and maize (144mg/N).

The chemical scores obtained for edible and wild

Table 2: Amino acid composition and chemical scores of *Dioscorea dumetorum* varieties

Amino acid	Edible <i>D. dumetorum</i> g/100g AA	Chemical Score	Wild <i>D. dumetorum</i> g/100g AA	Chemical Score
Tryptophan ^a	0.60	60	1.17	117
spartic acid	4.37		9.28	
Threonine ^a	1.74	43.5	2.93	73.25
Serine	1.92		3.43	
Glutamic acid	3.89		8.95	
Proline	1.32		2.84	
Glycine	1.62		3.95	
Alaline	2.64		3.68	
Cystine	0.45		0.84	
Valine ^a	1.98	39.6	3.60	72
Methionine ^a	0.54	28 ^b	1.09	54
Isoleucine ^a	1.38	34.5	2.59	64.75
Leucine ^a	2.28	32.57	4.60	65.71
Tyrosine ^a	0.96	39 ^c	2.01	83.67
Phenylalanine ^a	1.38		3.01	
Lysinea (total)	1.14	20.72	2.43	44.18
Histidine	0.72		1.34	
Arginine	1.93		4.68	

^aEssential amino acids, thus chemical scores. ^bValue of methionine was added to cystine to derive chemical score.

^cValue of Phenylalanine was added to tyrosine to derive chemical score

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varieties of *D. dumetorum* were 20 and 44, respectively. These values were lower than the value of 94 reported by Mbome *et al.* (Mbome *et al.*, 1995). However, the results of this study agreed with that of Mbome *et al.* on lysine as the most limiting amino acid (Mbome *et al.*, 1995). Aspartic and glutamic acids are dispensable amino acids and are found in significant quantities in both varieties of this yam but the wild *D. dumetorum* is richer than the edible variety. This is of importance, since most of the dispensable amino acids derive their α -amino groups from glutamic acid which, in turn has α -ketoglutaric acid and ammonia as its precursor. Equally, aspartic acid is a precursor of such essential amino acid as asparagines, methionine, threonine and lysine (Stryer, 1997).

The biological significance of the wild *D. dumetorum* cannot be over emphasized considering the levels of essential and non-essential amino acid contents of this yam variety. This is because of the several important biological functions of amino acids as building blocks for proteins. In conclusion, the findings of this study suggest that the wild *D. dumetorum* is richer and is of high protein quality than its cultivated counterpart. However, both varieties of *Dioscorea dumetorum* could be used as alternatives to cereals in human and animal nutrition or in livestock industries since they compare favourably in their amino acids compositions.

References

- A.O.A.C. Official Methods of Analysis, 2000. 17th Edn. Washington, Association of Official Analytical Chemists.
- Agbor, E.T. and S. Treche, 1983. Variability in the chemical composition of Yams grown in Cameroon. Proceedings of the 2nd triennial symposium on tropical root crops production and uses in Africa - Douala, Cameroon: Institute of Tropical Root Crops, 153-156.
- Coursey, D.G., 1967. Yam: An account of the nature, origins, cultivation and utilization of the useful members of Dioscoreaceae. England, London: Longmans.
- Delpuech, F. and J.C. Favier, 1980. Caracteristiques des amino de plantes alimentaires tropicales: Action de l'amylase, gonflement et solubilite. Anal. Technol. Agric., 27: 809-826.
- FAO/WHO, 1973. Adhoc expert committee on energy and protein requirements. WHO Tech. Report Series, 522.
- FAO/WHO/UNU, 1985. Energy and protein requirements. World Health Organisation Tech. Report Series, 724.
- Idusogie, E.O., 1971. The nutritive value per acre of selected food crops in Nigeria. J. W. Af. Sci. Assoc., 16: 17-24.
- Ihekeronye, A.I. and P.O. Ngoddy, 1985. Integrated Food Science and Technology for the Tropics. London: Macmillian Publishers Ltd.
- Malaurie, B., 1998. *In vitro* storage and safe international exchange of yam (*Dioscorea* spp.) germplasm. Electronic J. Biotechnol., @ <http://ejb.ucv.cl/review>.
- Martins, F.W. and R. Ruberte, 1975. Bitterness of *Dioscorea cayenensis*. J. Agric. Fd. Chem., 23: 1218-1219.
- Mbome, I.L., Agbor, E.T. and S. Treche, 1995. Digestibility and metabolism of flour from two yam species (*D. dumetorum* and *D. rotundata*) in school age children. Ecol., Fd. Nutri., 34: 217-225.
- Okonkwo, S.N.C., 1985. The botany of the yam plant and the exploitation in enhanced productivity of the crop. In: Osuji, G. (Ed.) Advances in Yam Research: The Biochemistry and Technology of the Yam Tuber, 29. Enugu: Biochemical Society of Nigeria.
- Onwueme, I. C., 1978. The Tropical Tuber Crops: Yams, Cassava, Sweet Potato and Cocoyams. Chichester: Wiley.
- Osagie, A.U., 1992. The yam tuber in storage. Benin: Post harvest Research Unit, Department of Biochemistry, University of Benin.
- Oyenuga, V.A., 1968. Nigeria foods and feeding stuffs: Chemistry and nutritive value. 3rd Edn. Ibadan: University Press.
- Robin, J.P., 1976. Comportement du grain amidon a l'hydrolyse acide menagee. Etude physicochimique et enzymatique de la fraction insoluble. Contribution a la connaissance de la structure de l'amylopectine. These de Doctorates-Sciences physique, CNRS AO 12534, Paris, France.
- Stryer, L., 1997. Biosynthesis of amino acids and heme. In: Biochemistry 4th Edn. W. H. Freeman and Company, New York, pp: 717-718.