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Antinutritional Assessment of *D. alata* Varieties

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Abstract: The antinutritional components of five hybrid varieties of water yam (*Dioscorea alata*) and two land races were evaluated. The antinutritional factors evaluated were phenol ranging from 0.16 to 0.27%; hydrogen cyanide, 9.62 to 12.00 mg/kg; alkaloids, 0.12 to 0.55%; tanmins, 46.50 to 180.25%; phytate, 0.22 to 0.28%; heamagglutinin, 1.22 to 5.75 Hu/g and trypsin inhibitor, 24.02 to 49.51. TI unit/mg. There were significant differences ($P < 0.05$) in some of the antinutritional factors among the water yam varieties investigated. Generally most of antinutritional factors are low to cause health hazard. The overall results are suggestive of high nutritional quality of the water yam varieties due to low presence of antinutritional factors compared to other tropical root crops.

Key words: Antinutrients, assessment, *D. alata* varieties, water yam

INTRODUCTION

Water yam (*Dioscorea alata*) is the most economically important yam species, which serve as a staple food for millions of people in tropical and sub-tropical countries (Hahn, 1995; Coursey, 1967). *D. alata* is a climbing plant with glabrous leaves and twining stems which coil readily around a stake (Udensi *et al.,* 2008). *D. alata* is a crop with potential for increased consumer demand due to its low sugar content necessary for diabetic patients. In Nigeria five high yielding and disease resistant water yam (*D. alata*) varieties have been developed by International Institute of Tropical Agriculture (Oselebe and Okorie, 2005). The nutritional and functional properties of these seven varieties have been reported (Udensi *et al.,* 2008). The report of their work indicated the possibility of selecting good varieties for intensive cultivation in Nigeria and other *D. alata* growing regions according to their chemical composition only. So far the antinutrient composition of *D. alata* varieties have not been widely reported. Antinutritional factors when present in a food system lower the bioavailability of protein and minerals. The present study aims at providing information on the antinutritional factors of five hybrid varieties of water yam and two land races. The objectives of this work were,

a) To evaluate the antinutrient composition of five *D. alata* varieties.
b) To assess the possibility of selecting good varieties according to their nutritional and antinutrient composition.

MATERIALS AND METHODS

Seven *D. alata* varieties: TDa 98/01166, TDa 98/01168, TDa 98/01178, TDa 99/00169, TDa 99/00240, TDa 297 (the institutional check) and a land race genotype "Okwalenkata" (the best local variety) were collected from the Faculty of Agriculture, Ebonyi State University Abakaliki, Nigeria. The varieties were cultivated in the same environment and all were given the same treatment. In this study, the yam tubers were harvested mature at the same time.

Sample preparation: The yam tubers were peeled, washed, sliced into cubes and dried in hot air oven at a temperature of 60°C to a moisture content of about 10%. The dried yam chips were then milled using locally fabricated attrition mill to obtain yam flour. The flour was sieved through 1 mm sieve and packaged in plastic containers for analysis.

Antinutritional factor studies: Alkaloid was estimated using the alkaline precipitation gravimetric method described by Harbone (1973). Trypsim inhibitor and heamagglutinin were determined according to the methods described by Arntifield *et al.* (1985). Phytic acid content was measured by the method of Davis and Reld (1979) while tannins were determined by the Folin-Denis Spectrophotometric method as described by Pearson (1976). Hydrogen cyanide content was determined by the method of Balagophalan *et al.* (1985). Total phenol content of the yam samples were determined by the Colometric method of (AOAC, 1990).

RESULTS AND DISCUSSION

The antinutrients of the *D. alata* varieties studied are presented in Table 1. The phenol content of the water yam varieties (0.16±0029 - 0.27±0.0058 %) is lower than the values obtained for *D. rotundata* as reported in literature. The low content of phenol in *D. alata* is responsible for the slow browning reaction during

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Table 1: The anti-nutritional factors of yam samples (*Dioscorea alata*)

Varieties	Phenol (%)	HCN (mg/kg)	Alkaloid (%)	Tannins (mg/100g)	Phytate (%)	Heamagglu-tinin (Hu/g)	Trypsin inhibitor (Tiunit/mg)
Tda 98/01166	0.22±0.0018[c]	11.40±0.0058[c]	0.24±0.0017[c]	46.50±0.029[g]	0.28±0.029[a]	5.75±0.0033[a]	49.51±0.0058[a]
TDa 98/01168	0.25±0.20[b]	11.51±0.013[b]	0.18±0.0033[e]	176.09±0.0082[b]	0.22±0.0033[d]	4.85±0.003[b]	39.00±0.0067[e]
TDa 98/01169	0.16±0.0029[d]	11.00±0.004[d]	0.36±0.0033[b]	54.75±0.0033[f]	0.25±0.0029[b]	5.75±0.0033[a]	48.02±0.015[b]
TDa 99/00176	0.27±0.0058[a]	12.00±0.004[a]	0.55±0.0033[a]	148.55±0.029[c]	0.22±0.058[d]	1.62±0.0017[e]	41.03±0.017[c]
TDa 98/00240	0.23±0.0058[c]	9.62±0.012[f]	0.23±0.0033[d]	92.55±0.029[d]	0.27±0.0029[a]	3.56±0.01[c]	24.02±0.02[g]
TDa 297	0.25±0.0047[b]	10.92±0.017[e]	0.12±0.0033[f]	65.57±0.35[e]	0.26±0.01[a]	1.22±0.01[e]	39.50±0.0033[d]
Local best	0.24±0.0029[a]	11.04±0.036[d]	0.12±0.00296[f]	180.25±0.0033[a]	0.24±0.0067[c]	2.02±0.38[d]	29.51±0.0033[f]

Means bearing different superscripts in the same vertical row are significantly different (P < 0.05)

Table 2: Proximate composition of *D. alata* varieties

Varieties	Moisture Content %	Ash %	Ether extract %	Crude protein %	Crude fibre %	Carbohy-drate %	Energy Kcal/100g
Tda 98/01166	6.52[b]	3.08[a]	1.10[a]	6.78[bc]	1.13[a]	87.64[a]	385.33[a]
TDa 98/01168	6.00[bc]	2.25[b]	0.90[b]	6.34[cd]	1.05[ab]	83.46[a]	367.30[a]
TDa 98/01176	7.50[a]	2.30[b]	0.78[c]	7.00[b]	0.80[bc]	81.62[a]	361.58[a]
TDa 99/00169	5.77[cd]	2.38[b]	0.75[c]	7.18[b]	0.88[bc]	83.04[a]	367.63[a]
TDa 99/00240	5.26[d]	3.15[a]	0.85[c]	8.31[a]	0.90[bc]	81.53[a]	367.01[a]
TDa 297	7.57[a]	2.65[ab]	1.03[ab]	5.69[ef]	0.75[c]	82.31[a]	361.27[a]
Local best	6.05[bc]	2.25[b]	0.75[c]	5.78[de]	0.83[bc]	84.34[a]	367.23[a]

Means with the same superscripts in the same column are not significantly different (P < 0.05). Culled from Udensi *et al.* (2008). The Investigation of Chemical Composition and Functional Properties of water yam (*Dioscorea alata*): Effect of varietal differences. Pakistan Journal of Nutrition. 7 (2): 342-344.

Table 3: Mineral contents of *D. alata* varieties (mg/100g)

Varieties	K	Na	P	Ca	Mg	Vitamin C
TDA98/01168	400.00[a]	200.00[b]	120.00[d]	60.12[b]	85.08[b]	18.48[cd]
TDA98/01178	380.00[a]	380.00[a]	140.00[cd]	60.12[b]	85.08[b]	20.22[cd]
TDA99/00240	380.00[a]	250.00[b]	340.00[a]	80.16[a]	24.31[d]	17.60[d]
TDA 98/01166	240.00[b]	190.00[b]	180.00[c]	40.08[c]	97.24[a]	16.72[d]
TDA 99/00169	320.00[ab]	200.00[b]	300.00[ab]	20.16[d]	60.77[c]	35.20[a]
TDA297	310.00[ab]	220.00[b]	260.00[b]	40.08[c]	97.24[a]	28.45[b]
Local best (LC)	260.00[b]	360.00[a]	100.00[d]	20.04[d]	60.77[c]	22.88[c]

Means with the same superscripts in the same column are not significantly different (P < 0.05). Culled from Udensi *et al*. (2008). The Investigation of Chemical Composition and Functional Properties of water yam (*Dioscorea alata*): Effect of varietal differences. Pakistan Journal of Nutrition. 7 (2): 342-344.

processing which is nutritionally important. Hydrogen cyanide content (Table 1) ranged from 9.62±0.017 - 12.00±0.004 mg/kg. These values are lower than the results for *D. cayenensis* (260 mg/kg) and *D. rotundata* (90 mg/kg) (Ozo *et al.,* 1984). Generally, hydrogen cyanide is known to be toxic, but the levels obtained in the hybrid varieties *D. alata* are quite below the toxic level of 50 mg/kg. The low levels of alkaloids presented in (Table 1) underscored the safety of the *D. alata* varieties studied when consumed, since most alkaloids are known to be toxic and can course a wide range of physiological changes in the body when consumed (Harbone, 1973). However, simple processing such as boiling removes the alkaloids present in most cultivated species of yams (Osagie and Opoku, 1992). The tannins (Table 1) ranged from 46.50±0.29 - 180±0.0033 mg/100g. The values are higher than that reported for *D. rotundata* (20 mg/100g) by Uka (1985), which implies that less protein may be available in the *D. alata* varieties than in *D. rotundata* due to protein-tannin complex formation. However, it is important to note that heat treatment which is normally given to D-alata before consumption will eliminate or reduce the level of tannin in the food system thereby making the protein available. The phytate contents of the seven *D. alata* varieties are relatively lower than that reported for *D. rotundata* and *D. esculenta* (Uka, 1985). The implication of the low values of phytate in these *D. alata* varieties is that the tubers will contain available minerals for absorption in the body. The heamaggluatinin level was low (Table 1) at the range of 1.22±0.01 - 5.75±0.003 (Hu/g) of the test samples. The low level of heamaggluatinin content of the yam varieties will be further reduced/eliminated during processing or cooking (Udensi *et al.,* 2005; Khokhar and Chauhan, 1986) to prevent red blood agglutination commonly caused by heamagglutinin. Table 1 shows the trypsin inhibitor contents of the test samples. The values are very high compared to those obtained for *Mucuna cochinchinensis* (7.47 TI unit/mg) and *Mucuna utilis* (13.00 TI unit/mg) by Ukachukwu and Obioha (1997) and Udensi *et al.,* 2004), respectively. The presence of large quantity of trypsin inhibitor in the body disrupts the digestive process and may lead to undesirable physiological reactions (Booth *et al.,* 1960). The processing method normally applied in the processing of *D. alata* will enhance the nutritional quality of the yam by reducing or eliminating the toxic substance. The varieties of *D. alata* investigated contain low levels of antinutritional factors, which ensure safety for both man and animal in food and feed composition. The protein and mineral contents of all the varieties indicate also product of good nutritional quality for the consumers. Farmers should therefore be encouraged to select varieties of high protein content for cultivation to prevent the problem of protein malnutrition and hunger. In terms of nutrient components, Udensi *et al.* (2008) reported average crude protein of 6.8 % (Table 2) for the *D. alata* varieties. Thus, *D. alata* should not be considered protein poor, as has been the case. Udensi *et al.* (2008) also reported the seven varieties as good sources of minerals (Table 3), which are nutritionally important.

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