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Full Length Research Paper

Effects of two processing methods on some nutrients and anti-nutritional factors in yellow yam (*Dioscorea cayenensis*)

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Raw and processed tubers from eight genotypes of yellow yam (*Dioscorea cayenensis*) were evaluated for their contents of iron, zinc, calcium, phosphorus, total carotenoids, vitamin C, phytic acid and tannin. The mean values obtained (in mg/kg on dry weight basis) were 7.2 for iron, 9.2 for zinc, 169.3 for calcium, 1331.3 for phosphorus, 181.8 for phytate and 353.6 for tannin. Similarly, 6.31 µg/g of total carotenoids and 37.3 mg/kg of ascorbic acid were obtained on fresh weight basis. The genotypes differed significantly (P < 0.05) in tuber contents of zinc, calcium, phosphorus, total carotenoids and vitamin C but they were similar with respect to iron, phytate and tannin contents. Genotype TDc 95-65 had the highest levels of zinc, calcium, total carotenoids and phytate while TDc 95-294 had the highest levels of iron and phytate. Tubers of TDc 95-65, TDc, 95-294, TDc 04-168 and TDc 98-136 are good sources of iron, zinc and phosphorus. The two cooking methods had little effect on the minerals but significantly reduced the levels of total carotenoid, vitamin C, phytate and tannin contents.

Key words: Antinutrients, boiling, *Dioscorea cayenensis*, phytic acid, pounding and tannin.

INTRODUCTION

Yam, *Dioscorea* species is an important staple in much of West Africa (Omonigho and Ikenebomeh, 2000). Annual world production of yam is about 40 million tonnes and per capita consumption is estimated to be 256.4 g per day in the major production zones (FAOSTAT, 2005). Yam is of higher nutritional value than some other root and tuber crops such as cassava (Latham, 1969) . Its pro-tein content is about 3 - 6% as compared to 1 - 2% in cassava (Charles et al., 2004). Yams are reported to contain relatively high levels of minerals (Afoakwa and Sefa-Dedeh, 2001). Iron is an important trace element in the human body. It plays crucial roles in haemopoiesis, control of infection and cell mediated immunity (Beard, 2001). Iron deficiency anaemia is the most prevalent nutritional deficiency and is estimated to affect more than one billion people worldwide (Trowbridge and Martonell, 2002). The Nigeria food consumption and nutrition survey 2001 - 2003, showed that 27.45% of children less than five years, 24.3% of mothers and 35.3% of pregnant women are suffering from iron deficiency (Maziya-Dixon et al., 2004). Zinc is an essential micronutrient necessary for human growth and immune functions (Black, 2003). An estimated 20% of the world population is reported to be at risk of inadequate zinc intake (Hotz and Brown, 2004). The Nigeria Food survey showed that zinc defi-ciency affects 20% of children less than five years, 28.1% of mothers and 43.9% of pregnant women (Maziya- Dixon et al., 2004). Yellow yam (*Dioscorea cayenensis*) is an important species of cultivated yam based on the sig-nificant role it plays in the diet of many people in coastal West Africa, selected countries in East and Central Africa, and in the Caribbean region. It is known to contain carotenoids which represent the most widespread group of naturally occurring pigments in nature (Martin and Ruberte, 1975). Carotenoids are primarily of plant origin and -carotene which predominates (Chandler and Schwartz, 1988), serves as an important nutritional component in foods. It is a major precursor of vitamin A and provides pleasant yellow- orange colors to foods (Si-mon, 1997). Dietary vitamin A deficiency causes debilitating health problems such as

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xerophthalmia, corneal lesions, keratomalace and in very severe cases blindness (Passmore and Eastwood, 1986). The World Health Organization (1995) reported these problems affecting young children in Africa. Yams are also known to contain some antinutritional components that may have adverse effects on human nutrition (Dipak and Mukherejee, 1986). These are mainly tannins, phenols and phytic acid. Phytic acid (inositol hexaphosphate) is an organic acid found in plant materials (Heldt, 1997). It combines with some essential elements such as iron, calcium, zinc and phos-phorus to form insoluble salts called phytate which are not absorbed by the body thereby reducing the bioavaila-bility of these elements.

Two principal traditional methods used for preparing yams for consumption in coastal West Africa, especially Nigeria, are boiling tuber pieces and pounding into a dough after boiling (Omonigho and Ikenebomeh, 2000). Several traditional household food-processing methods can affect the bioavailability of nutrients in plant-based diets. These include thermal processing, mechanical processing, soaking, fermentation and germination, (Hotz and Gibson, 2007). In spite of the importance of yellow yam as a food source, only few studies have been done to provide information on the mineral, total carotenoid, vitamin and antinutritional contents of ready-to-eat yams, that is, either the boiled or pounded product. The purpose of this study was to evaluate the chemical composition of tubers of eight genotypes of yellow yam and the effect of domestic cooking methods on their nutritional quality.

MATERIALS AND METHODS

Tubers from eight genotypes of yellow yam, TDc 04-167, TDc 04-168, TDc 04-169, TDc 04-170, TDc 95-293, TDc 95-294, TDc 95-65 and TDc 98-136 were planted at the experimental field of the International Institute of Tropical Agriculture (IITA), Onne, Nigeria. The design was a randomized complete block with three replications. The tubers were harvested nine months after planting by which time all leaves had senesced. Five healthy tubers were selected per genotype per plot from each of the three replications.

Sample preparation and cooking methods

The tubers were washed and each was split into four longitudinal sections with a stainless steel knife. Sub-samples containing a section of each yam tuber were selected and divided into three portions. The first portion was used for analysis as raw. The second portion was boiled in distilled water (1:2 w/v) for 20 min, excess water was drained off as is the usual household practice and samples were left to cool. The third portion was cooked in a yam pounder (Model sd-900Y, National electronic co. ltd., Tokyo, Japan) by adding distilled water (1:2 w/v) for 15 min and then pounded for another 10 min. The weight of yam and volume of water used were enough to give pounded yam of same consistency as that of the conventionally prepared pounded yam using mortar and pestle.

Fresh samples were used for determination of ascorbic acid and total carotenoid contents. For other analyses, samples were dried in a convection oven (Gallenkamp Hotbox Oven, size 2, Gallenkamp, UK) at 60°C for 48 h. The dried samples were milled into flour using an analytical mill (Analysenmuhle Type A10, 79219 STAUFEN, Janke and Kunkel, GmbH and co. KG, IKA Labortechnik, Germany.) and stored in airtight plastic bags at -4°C until used.

All determinations were carried out in duplicate, giving six values per genotype for each parameter (considering the three replications in the field).

Chemical analyses

Total carotenoid content was determined spectrophotometrically as described by Rodriguez- Amaya (1999). Ascorbic acid content was determined according to the AOAC, 1990 method. For analyses of minerals, dried and milled yam samples were sent to the Waite Analytical Service Laboratory, Adelaide, Australia and analyzed there using Inductively Coupled Plasma Atomic Emission Spectrometry (ICPAES), (Made in Switzerland by ARL model 3580 B), (Zarcinas et al.,1987).

Phytic acid (phytate) content was determined by the method of Wheeler and Ferrel (1971). Tannin was determined using the Vanillin-HCL method as modified by Chang et al., (1994), using catechin as the tannin standard. The tannin content was expressed as 'catechin' equivalents.

Statistical analysis

Samples from each of the three replicates for each genotype was taken and analyzed in duplicate. Data were subjected to analysis of variance (ANOVA) using statistical analysis system (SAS) version 8.02 (SAS, 2000) and Duncan's multiple range test.

RESULTS AND DISCUSSION

The tuber iron contents ranged from 6.7 - 7.9 mg/kg on dry matter (DM) basis with a mean value of 7.2 mg/kg DM (Table 1). These are similar to values reported by Bell (1984); Bradbury and Holloway (1988) and USDA (2003). There were no significant differences among the genotypes (P = 0.79) for iron content.

The iron content varied little between the raw and processed products, showing inconsistency in the changes (increase or decrease) among the eight genotypes studied (Table 2). Increase in the iron content may be due to contamination of iron from the cooking utensils. Our observations are similar to reports by Bell (1984) which showed that iron content increased slightly when tubers were peeled and boiled. The recommended dietary allowance (RDA) for iron is 10 mg/day (RDA, 2008) since iron is not significantly reduced by processing, genotypes TDc 95-294, TDc 04-168 and TDc 95-65 will contribute 39.5% of the RDA requirement for iron if a 500 g yam meal is consumed. Yam is also not eaten alone but often with a vegetable sauce, additional minerals obtained from the sauce can increase the iron content of the meal.

The zinc content ranged from 8.4 - 10.9 mg/kg DM with a mean value of 9.2 mg/kg DM (Table 1). Results obtained are similar to reports by Bell (1984) and USDA (1999). TDc 95-65 had the highest level (P = 0.05) of zinc (10.9 mg/kg DM) followed by TDc 95-294 (10.2 mg/kg). The reduction in the zinc content due to primary processing was slight (Table 2). Bell (1984), reported similar findings in peeled and boiled tubers of *D. cayenensis*. The RDA

Table 1. Micronutrient content (mg/kg)[a] in raw, boiled and pounded[b] tubers from eight genotypes of yellow yam.

Genotype	Iron			Zinc		
	Raw	Boiled	Pounded	Raw	Boiled	Pounded
TDc 04-167	6.7 ± 0.3a	7.1 ± 0.8	7.0 ± 0.4	8.6 ± 0.7b	9.1 ± 2.5	7.7 ± 0.9
TDc 04-168	7.8 ± 1.9a	9.1 ± 1.8	8.7 ± 0.2	9.6 ± 1.9ab	10.4 ± 2.2	10.3 ± 1.4
TDc 04-169	7.0 ± 0.9a	7.5 ± 1.3	8.2 ± 1.4	9.0 ± 0.3b	8.5 ± 0.5	9.0 ± 0.7
TDc 04-170	7.2 ± 1.2a	6.1 ± 0.8	6.3 ± 0.8	8.7 ± 0.9b	8.1 ± 0.9	8.2 ± 0.7
TDc 95-293	6.7 ± 1.4a	7.0 ± 0.8	7.8 ± 0.8	8.4 ± 0.3b	8.3 ± 0.3	8.8 ± 1.2
TDc 95-294	7.9 ± 0.3a	8.0 ± 0.2	8.7 ± 1.8	10.2 ± 1.5ab	8.7 ± 1.1	9.9 ± 2.6
TDc 95-65	7.3 ± 1.1a	7.2 ± 0.7	7.8 ± 1.6	10.9 ± 1.2a	9.4 ± 2.4	10.1 ± 2.5
TDc 98-136	6.9 ± 1.1a	6..9 ± 1.4	7.2 ± 1.4	8.5 ± 0.8b	7.6 ± 1.6	7.9 ± 1.4
Range	6.7 - 7.9	6.1 – 9.1	6.3 – 8.7	8.4 – 10.9	7.6 – 10.4	7.7 – 10.3
Mean	7.2	7.4	7.7	9.2	8.8	9.0

[a]Means of two determinations in each of three replicate samples expressed on dry weight basis, ± Standard deviation. Values with same subscripts in the same column are not significantly different at $P < 0.05$
[b]Pounded refers to a combination of the processes of boiling and kneading into a dough.

for zinc is 15 mg/day (RDA, 2008) . Consumption of 500 g of TDc 95-65 and TDc 95-294 will contribute 36.3% of the RDA. Values obtained in this study shows that *D. caye-nensis* is a good source of zinc.

The calcium content ranged from 75.2 - 263.2 mg/kg on dry matter basis with a mean value of 169.3 mg/kg DM (Table 3) and are similar to values reported for several cultivated yam species (Bradbury, 1988) . The highest value was recorded for TDc 95-65 (263.2 mg/kg) which was significantly different ($P < 0.05$) from values for TDc 04-169, TDc 04-170, TDc 04-168 and TDc 95-294. The calcium content increased significantly for most of the genotypes (TDc 04- 168, TDc 04-169, TDc 04-170, TDc 95-293, TDc 95-294 and TDc 98-136) when tubers were boiled and pounded (Table 2). Bradbury et al., (1988) reported similar findings in which an increase in the calcium content was observed when yam tuber was boiled. The RDA for calcium is 800 mg/day (RDA, 2008), consumption of a 500 g yellow yam meal will contribute 16.5% of the RDA. The yellow yam genotypes are not good sources of calcium.

Phosphorus content in this study ranged from 1200 - 1576.7 mg/kg DM with a mean value of 1331.2 mg/kg (Table 3) which was about six times the calcium content in the tuber. This is similar to earlier reports by Obigbesan and Agboola (1978). Tubers of TDc 98-136 were significantly different from TDc 04- 167, TDc 04-168, TDc 04-169, TDc 04-170, TDc 95-293 and TDc 95-294 ($P < 0.05$). TDc 98-136 was observed to have the highest level of phosphorus, (1576.7 mg/kg) followed by TDc 95-65 (1373.3 mg/kg) and TDc 95-294 (1350.0 mg/kg). Boiling resulted in slight decrease (6.98 – 19.50%) in phosphorus content of all the genotypes studied (Table 2). The RDA for phosphorus is 500 mg/day (RDA, 2008). Consumption of a 100 g yam meal will contribute 31.6% of the RDA. From FAOSTAT, 2005, yam consumption per capita is estimated to be 256.4 g per day. Yellow yams are good sources of phosphorus.

The total carotenoid contents ranged from 3.40 - 10.86 µg/g on fresh matter basis with a mean value of 6.31 µg/g (Figure 1). Significant variation in the carotenoid content was observed among the genotypes ($P < 0.05$). Duncan's multiple range tests grouped the genotypes into two, based on their carotenoid content. TDc 95-293 (10.58 µg/g), TDc 95-294 (8.65 µg/g) and TDc 95-65 (10.86 µg/g) had significantly higher carotenoid content than TDc 04-167 (4.33 µg/g), TDc 04-168 (4.73 µg/g), TDc 04-169 (4.45 µg/g), TDc 04-170 (3.40 µg/g) and TDc 98-136 (3.44 µg/g) ($p < 0.05$). The yellow coloured tubers of yam generally do contain useful amounts of carotene or provitamin A as has been identified by Martin and Ruberte (1975). Large variation in total carotenoid content observed among the eight genotypes was a reflection of the wide spectrum of the colour of flesh of the yellow yam tubers. These results agree with earlier conclusion that carotenoids, especially -carotene are largely responsible for the yellow or orange-fleshed colour in *Dioscorea cayenensis* (Martin and Ruberte, 1975). A similar observation has been reported in sweet potato (De Almeida-Muradian et al., 1992). The RDA for vitamin A is 800 - 1000 µg retinol equivalent (RE)/day for adults, whereas children and infants require 500µg RE/day (RDA, 2008). Low et al., (1997) suggested that cultivars having more than 100 µg retinol equivalent (RE) per 100 g fresh roots were good sources of vitamin A. Tubers of TDc, 95-293, TDc 95- 294 and TDc 95-65 having high carotenoid content can be said to be good sources of this micronutrient. Khachik et al. (1992) reported that various cooking procedures affected the carotenoid content of green vegetables. This study recorded a decrease of 27.65 - 42.92% of total carotenoids on boiling and 31.18 – 47.05% on boiling followed by pounding (Table 2), thus affecting the nutritional value of those genotypes known to be potentially high in carotenoid content. This loss is due to the

Table 2. Changes (%) in the content of nutrients and antinutrients of boiled and pounded[b] tubers of yellow yam as compared with raw samples.

Genotype	Boiled								Pounded							
	TDc 04- 167	TDc 04-168	TDc 04-169	TDc 04-170	TDc 95-293	TDc 95-294	TDc 95-65	TDc 98-136	TDc 04- 167	TDc 04- 168	TDc 04-169	TDc 04-170	TDc 95-293	TDc 95-294	TDc 95-65	TDc 98-136
Iron	+5.97	+16.67	+7.14	-15.28	+4.48	+1.27	-1.37	0	+4.48	+11.54	+17.14	-12.50	+16.42	+10.13	+6.85	+4.35
Zinc	+5.81	+8.33	-5.56	-6.90	-1.19	-14.71	-13.76	-10.59	-10.47	+7.29	0	-5.75	+4.76	-2.94	-7.34	-7.06
Calcium	-13.97	+43.03	+98.40	+56.30	+63.55	+64.33	+27.93	+120.94	-35.31	-29.29	+52.79	+33.39	+6.65	+8.88	-8.59	+29.00
Phosphorus	-10.26	-13.39	-11.11	-17.39	-10.56	-19.50	-17.72	-6.98	-7.89	+3.54	+5.29	-9.97	+0.83	-2.96	-3.64	-1.27
Total carotenoids	-40.42	-42.92	-34.61	-27.65	-28.64	-42.31	-28.73	-35.17	-41.11	-43.55	-38.20	-31.18	-39.98	-47.05	-38.67	-37.21
Vitamin C	-43.41	-47.33	-47.92	-48.41	-43.30	-36.39	-38.81	-41.30	-42.44	-49.56	-52.08	-49.09	-47.13	-40.82	-43.91	-44.02
Phytate	-28.33	-32.49	-25.51	-13.01	-22.94	-32.07	-26.22	-33.01	-32.18	-33.21	-28.34	-18.95	-29.22	-34.27	-28.22	-35.15
Tannin	-38.89	-33.05	-32.02	-34.26	-43.85	-45.05	-45.73	-49.59	-36.05	-34.11	-36.94	-39.76	-53.97	-45.93	-51.29	-51.11

+ = % increase; - = % decrease [b]Pounded refers to a combination of the processes of boiling and kneading into a dough.

Table 3. Macronutrient content (mg/kg)[a] in raw, boiled and pounded[b] tubers from eight genotypes of yellow yam.

Genotype	Calcium			Phosphorus		
	Raw	Boiled	Pounded	Raw	Boiled	Pounded
TDc 04-167	209.0 ±105.0ab	179.8 ± 66.7	135.2 ± 76.0	1266.7 ± 125.0b	1136.7 ± 15.3	1166.7 ± 212.2
TDc 04-168	155.0 ± 50.1bc	221.7 ± 37.5	109.6 ± 36.1	1320.0 ± 122.9b	1143.3±145.7	1366.7 ± 130.5
TDc 04-169	75.2 ± 16.1d	149.2 ± 45.4	114.9 ± 25.2	1260.0 ±160.9b	1120.0 ± 26.5	1326.7 ± 35.1
TDc 04-170	122.2 ± 54.3cd	191.0 ± 60.7	163.0 ± 41.8	1303.3 ±170.1b	1076.7±232.9	1173.3 ± 176.7
TDc 95-293	197.0 ± 80.3abc	322.2 ± 175.2	210.1 ± 17.1	1200.0 ±137.5b	1073.3 ± 90.2	1210.0 ± 43.6
TDc 95-294	144.1 ± 47.6bcd	236.8 ± 81.3	156.9 ± 125.3	1350.0 ± 72.1b	1086.7 ± 15.3	1310.0 ± 60.0
TDc 95-65	263.2±291.7a	336.7 ± 120.6	240.6 ± 130.4	1373.3± 27.2ab	1130.0±150.0	1323.3 ± 140.1
TDc 98-136	188.6 ± 46.4abc	416.7 ± 100.2	243.3 ± 45.1	1576.7 ± 89.6a	1466.7 ± 86.2	1556.7 ± 83.3
Range	75.2 – 263.2	149.2 – 416.7	109.6 – 243.3	1200.0 – 1576.7	1073.3-1466.7	1166.7–1556.7
Mean	169.3	275.4	171.7	1331.3	1154.2	1304.2

[a]Means of two determinations in each of three replicate samples expressed on dry weight basis, ± Standard deviation.
Values with same subscripts in the same column are not significantly different at $P < 0.05$. [b]Pounded refers to a combination of the processes of boiling and kneading into a dough.

that carotenoids are heat-labile compounds and undergo oxidation and degradation upon exposure to heat, light, acids, metals and enzymes (K'osambo et al*.,* 1998*)*. Carotenoids are easily oxidized because of the large number of conjugated double bonds in the compounds (Krinsky et al*.*, 1990) . The loss in carotenoid content was higher for pounding as carotenoids degrade with longer processing time at higher temperatures and cutting or maceration of the food (Rodriguez-Amaya, 1997). The ascorbic acid contents ranged from 18.4 - 52.2 mg/kg on fresh weight basis (FW) with a mean of 37.3 mg/kg FW (Figure 2). TDc 95-293 had the highest level of ascorbic acid (52.2 mg/kg). TDc 04-168 and TDc 04-170 recorded 45.0 and 44.0 mg/100g respectively. The ascorbic acid content in the fresh yam tubers as found to vary greatly between genotypes. High variability

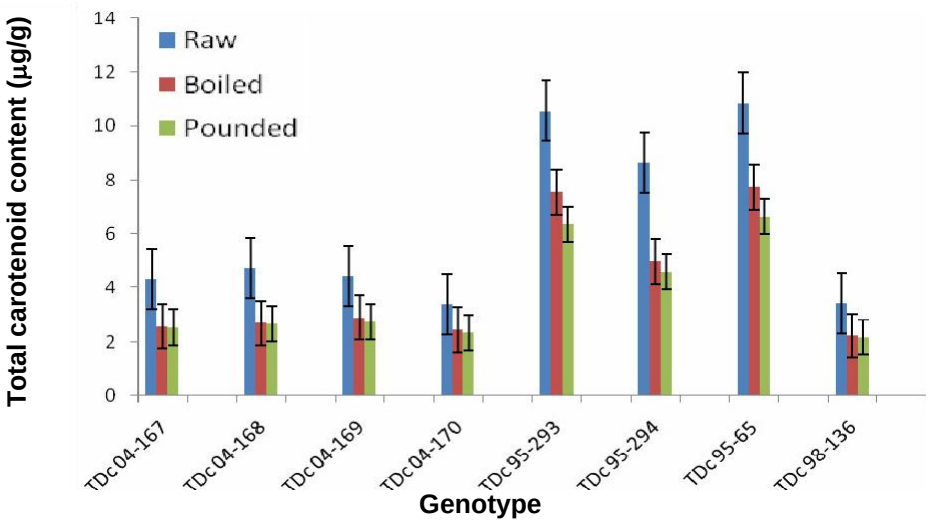

Figure 1. Total carotenoid contents in raw, boiled and pounded tubers from eight genotypes of yellow yam.

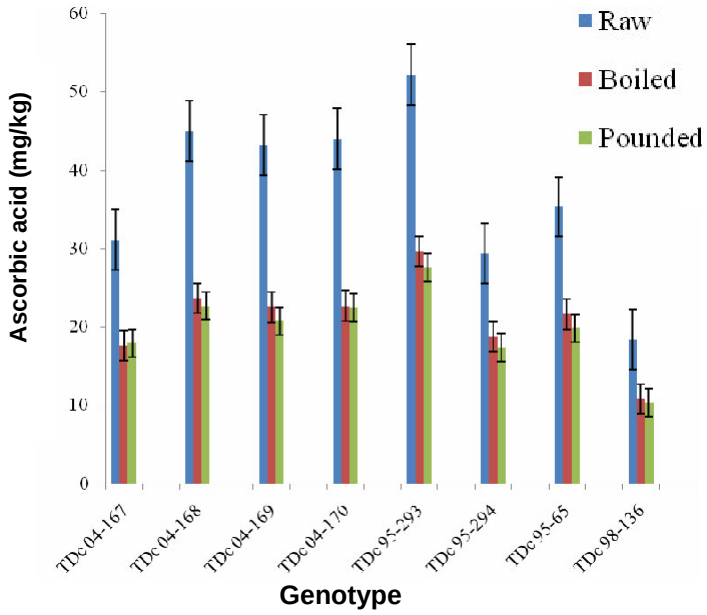

Figure 2. Ascorbic acid content in raw, boiled and pounded tubers from eight genotypes of yellow yam.

has been reported to exist in the ascorbic acid content of fruits and vegetables (Mozafar, 1994) . The values obtain-ed were similar to those reported by Bradbury and Holloway (1988); Bradbury and Singh (1986). Boiling and pounding reduced the ascorbic acid content in all the genotypes (Table 2). The reduction observed was between 36.39 - 48.41% for boiling and 40.82 - 52.08% for pounding. Ascorbic acid is the least stable of all the vitamins and is easily destroyed by heat, light, oxidation and alkalinity (Sood and Malhotra, 2001) . The recommended dietary allowance (RDA) for ascorbic acid is between 40 - 60 mg/day for infants and adults (RDA, 2008). Consumption of a 500 g meal of tubers of TDc 95-293, TDc 04-168 and TDc 04-170 will provide about 21 - 26 mg of ascorbic acid of which a significant proportion (almost half the content) is lost during processing.

Phytate content ranged from 166.2 - 194.9 mg/kg on dry matter basis with a mean of 181.8 mg/kg) (Figure 3). The

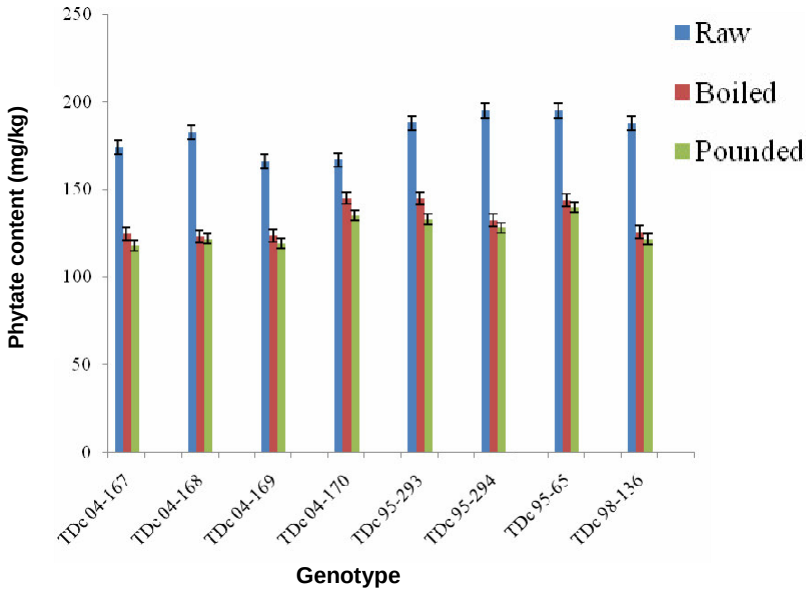

Figure 3. Phytate content in raw, boiled and pounded tubers of eight genotypes of yellow yam.

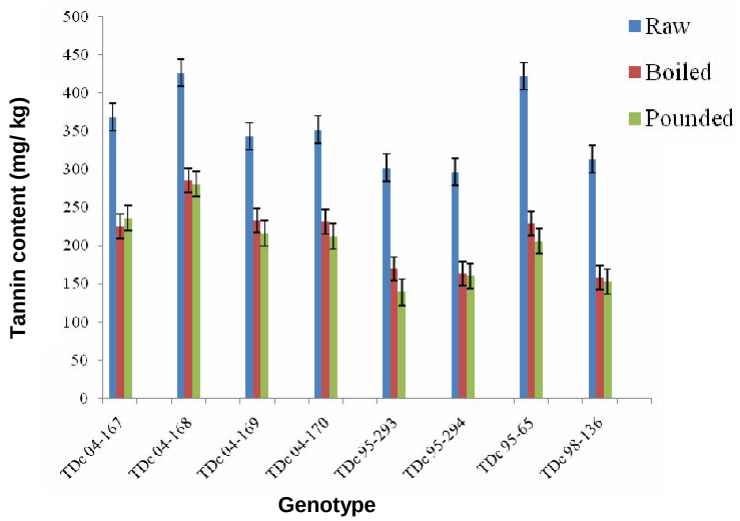

Figure 4. Tannin content in raw, boiled and pounded tubers from eight genotypes of yellow yam.

highest levels were obtained in TDc 95-294 (194.9 mg/kg) and TDc 95-65 (194.9 mg/kg) both having same values.

These values are lower than the phytate level (360 mg/kg) reported for Nigerian yam species (Osagie et al.,1996), higher than the 37.0 mg/kg reported for *D. cayenensis* tubers by Udoessien and Ifon (1992), and much lower than 4520 mg/kg reported by Adeyeye et al., (2000) . Results of our study showed that *D. cayenensis* tubers have fairly low phytate contents. No significant difference was observed among the genotypes (P = 0.98).

This is important because high phytate content is of significance as it lowers the availability of many essential minerals. Phytate could be substantially reduced or eliminated by soaking, germination and cooking (Martin-Cabrejas et al., 2004). Our study showed that all the genotypes studied recorded a loss of between 13.01 and 33.01% on boiling and 18.95 and 35.15% on boiling followed by pounding (Table 2). Reports by Beal and Mehta (1985) showed cooking reduced phytate content of peas by 13%. Marfo et al., 1990, reported that cooking had a greater reducing effect on phytate levels in the tubers

(yam, cocoyam and cassava) than in the cereals and legumes.

The tannin content ranged from 297 - 427.2 mg/kg on dry matter basis with a mean of 353.6 mg/kg DW (Figure 4). These values are comparable to those reported for yellow yam (300 mg/kg) by Udoessien and Ifon (1992), but lower than those reported for water yam (1300 mg/kg) by Osagie et al. (1996) and for other widely consumed food crops, for example, 2600 - 23700 mg tannin per kg in sorghum (Ford and Hewitt, 1979). No significant difference was observed for tannin content among all the eight genotypes ($p = 0.63$). Boiling and pounding of all the genotypes studied resulted in decreases of 32.02 - 49.59% and 34.11 - 53.97% respectively of tannin content (Table 2). The decrease in the levels of these antinutrients during heat treatment might be due to thermal degradation and denaturation of the antinutrients as well as the formation of insoluble complexes (Kataria et al., 1989). Tannin content of most food is usually reduced by processing and this has been reported to enhance the bioavailability of iron. Pounding resulted in greater loss of the antinutrients and this might be attributed to heat and disruption during the pounding process.

Conclusion

The variations observed in zinc, calcium, phosphorus, vitamin C and total carotenoid contents can be of advantage in breeding programmes designed to improve the nutritional quality of yam. Tubers of TDc, 95-65, TDc 95-294, TDc 04-168 and TDc 98-136 are good sources of iron, zinc and phosphorus since they can provide a substantial amount of these mineral requirements in West Africa where daily consumption may exceed 1 kg/person. Additionally, boiling and pounding slightly affected only the iron, zinc and phosphorus contents of yellow yam tubers. Vitamin C and total carotenoid contents, though present in substantial amounts that can contribute significantly to the recommended dietary allowance, were observed to be reduced greatly by both food preparation methods with the reduction more pronounced on pounding. Yellow yam was found to have low levels of antinutrients when compared to values recorded in some legumes and pulses. These antinutrients were further reduced during processing and should therefore not pose a problem to human health. Both methods of food preparation were effective in reducing the levels of antinutrients, thereby improving the bioavailability of minerals such as iron, zinc and calcium known to be affected by these anti-nutrients.

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