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ANT NUTRITIONAL FACTORS OF FALSE YAM (Icacina tricachantha) FLOUR

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Abstract

False yam (Icacina trichantha) tubers were processed into different flour samples: the raw, steeped - sun – dried (SSD), steeped-oven-deried (SOD), blanched-sun dried (BSD) and blanched- oven- dried (BOD) samples. The antinutritional factors of the samples were studied. The hydrogen cyanide contents ranged between 0.231 to 0.520mg/100g, 167.200 to 256.900mg/100g for total oxalate; 5.133 to 21. 68mg/100g for tannin; 1671 to 3.850mg/100g phytate and 1.365 to 3.120mg/100g for alkaloids. Some of the antinutritional factors were found to be below the lethal dose range for humans. Processing affected the levels of antinutrients of the flour samples.

Key words: processing, antnutritional factors, false yam tube flour.

Introduction

False yam is a shrubby perennial, small and drought - resistant plant which sends up erect leafy shoots from a large, underground fleshy tuber. It belongs to the family of Icacinaceae. It is indigenous to West and Central Africa. It is known as Bankanas or Kouraban in Senegal, Basouna in West Africa, Manankaso in Gambia, Pane in Sudan, and Takwara in Ghana (kay, 1987). It is kown as Urumbia or Eriagbo among the Ibos, Gbegbe by the Yorubas (Asuzu and Abubakar, 1995), Efikison by the Ibibios (Etukudo, 2003) all in Nigeria.

False yam tubers, which resembles large turnips or beet roots in such a great source of emergency moisture and food energy to the plant that it can survive at least four years without rain. Thus as long as false yam is around, food is always available for people (NRCNAP, 2008).

The chemistry of "Icacina" has it that 0.08% icacinone and 0.03% Icacinol were isolated from the plant. In addition, 3-0-β-D glucosides of β -sitosterol and stigmaterol have been found (Neuwinger,1996).

It has been reported that the objective of processing includes the extraction of non-protenacious component; to remove undesirable taste and odour component;

to remove or inactivate nutritionally undesirable components; to prepare a protein material that is suitable for application in food products (Iwe, 2003).

Fagbemi "et al" (2005) reported that processing significantly reduced antinutritional factor in foods. Apart from nutrients, food crops contain other components, some of which originate from within the food crops. They are biosynthesized products of food crops sources, in much the same way as nutrients are. These biosynthesized non-nutrient intrinsic food components exhibit outright antinufritional properties, by outright toxicity to man and/or animals or can decrease nutrient bio-availability/ utilization (Okaka and Okaka, 2005).False yam has been reported to contain hydrocyanic acid, phytic acid and oxalic acid –the same bitter principle as cassava, a global staple (Antai and Nkwelang,1999). False yam is yet to gain recognition and popularity as a food crop. Processing it into stable flour and analyzing its antinutritional composition will make the crop known to a greater majority of the people as a food crop. This study is therefore aimed at analyzing the antinutritional contents of false yam in order to evaluate its potential food uses.

Materials and Methods

Sample preparation/experimental procedures, The tubers of false yam (Icacina trichantha) were obtained from the Akwa Ibom State College of Agriculture.(now defunct), Obio Akpa in Oruk Anam L.G.A. of Akwa Ibom State. The

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plant was identified in the Department of botany University Uyo, Uyo, Akwa Ibom State, Nigeria.

Preparation of steeped-sun-dried flour sample, The tubers were cleaned, peeled, and washed before cutting into little bits, using kitchen knife, of uniform sizes as described by Kay (1987). They were then soaked in clean water for about 24h, after which they were sun dried. That was followed by pulverization, using a CORNA LANDERS and CIA.

S.AK Manuel grinder, and was sieved using 500mm mesh size. The flour obtained was packaged in a dry polyethylene sack, labeled "SSD" and stored for subsequent use.

Preparation of steeped-oven dried flour sample, The same method for steeped-sun-Dried sample was used excepting that instead of drying with the sun, oven was used for the drying process at a temperature of 500c. The flour obtained was packaged, labeled 'SOD' and stored in a cool dry place for subsequent use.

Preparation of Blanched-oven-Dried flour sample, The freshly cleaned, peeled and sliced (5mm thickness) tubers of false yam were dipped in boiling water for a brief length of time as described by Okaka and Okaka (2005). They were then drained and dried in an oven 500c.

Dry chips were pulverized and sieved. The flour obtained was packaged and labeled, "BOD".

Preparation of blanched-sun Dried flour sample, The same method for the preparation of Blanched- Oven Dried sample as described by Okaka and Okaka (20050 was used, except in the process of drying. The sun was used instead of oven. The obtained flour sample was labeled as "BSD".

Determination of Antinutritional factors, The following antiuntritional factors of false yam tuber were determined namely: Hydrocyanide (HCN) oxalates, phytate, tannins and alkaloids.

Hydrocyanide- this was determined using the alkaline picrate method- by sepectrophotomer as described by Egan and Bradbury (1998). Five (5) g of the flour sample was made into paste. The paste was then dissolved in 50ml distilled water in a conical flask and corked.

The extraction process was allowed to stay and overnight, and then filtered. To 1ml of the filtrate in a corked test tube, 4ml of alkaline picrate was added and incubated for 5minutes in a water bath. After a reddish brown colour development, absorbance was read in the spectrophotometer at 490mm. The absorbance of the blank containing 1ml distilled water and 4ml alkaline picrate solution was also read. The cyanide content was then extrapolated from the cyanide standard curve.

Oxalates- Determination of Oxalates involved three major steps: Digestion, oxalates precipitation and permanganate titration (Oke,1969).

Digestion, Two and half 92.5)g of the flour sample was mixed with 95ml distilled water and 5ml 6N HCl in a 250ml beaker. The mixture was then heated at 500c for 2h using water bath, filtered and diluted to 125ml with distilled water.

Oxalation precipitation, four (4) drops of methyl red indicator was added to 50ml of the filtrate in a 100ml beaker, evaporated to 25ml volume and filtered. The filtrate was treated with 5ml concentrated NH4OH, heated again to 900c, 10ml 5% CaCl2 solution added with constant stirring. It was cooled and left over-night at 50c, centrifuged at 2500rpm for 5minutes, supernatant decanted and the precipitate obtained, washed with 10ml 20% (v/v) H2SO4 solution and total volume diluted to 125ml distilled water.

Permanganate titration, Aliguots of 125ml of the solution was heated to 900c, titrated against 0.05N KMnO4 solution to a faint pink colour, and the calcium oxalate content calculated thus:

10ml of 0.05N KMnO4 = 2.2mg oxalate.

Phytic Acid (phytate) – this was determined according to the method described by Mecance and Widdowson (1955). Two and half (2.5) of the sample was extracted with 50ml 3% TCA for 30minutes, centrifuged and transferred into a 40ml conical flask. Four (4) ml FeCl3 solution was added, heated in a boiling water bath for 45minutes, centrifuged and carefully decanted. The precipitate was washed with 20ml 3% TCA, heated and centrifuged. Then dispersed in a few ml of water and 3ml of 1.5m NaOH added with mixing. The volume was brought to 30ml with water, heated for 30minutes, centrifuged and carefully decanted.

The precipitate was washed again with hot water re-centrifuged and decanted. Then dissolved with hot 40ml 3.2M HNO3, transferred into a 10ml standard flask, cooled to room temperature and diluted to volume with distilled water.

Tannins- The Folin-Dennis spectrophotometric method was used, as described by Pearson (1976). One (1) g of the sample was dispersed in 10ml distilled water, agitated and allowed to stand for 30minutes at room temperature, then centrifuged. Two and half (2.5) ml of the supernatant, 2.5ml of tannic acid solution were dispersed into a 50ml flask respectively. One (1) ml Folin Dennis reagent was added to each flask followed by 2.5ml of saturated Na2CO3 solution. The mixture was then diluted to make (50ml) and incubated for 90 minutes at room temperature. The absorbance was measured at 250mm in a Benway model 6000 electronic spectrophotometer.

% Tannin = An/As x C x 100/W x Vf/Va

Where:

An =Absorbance of test sample

As = Absorbance of standard solution

C = Concentration of standard solution

W = Weight of sample

Vf = Total volume of extract

Va = volume of extract analyzed.

Alkaloids- The gravimetric method of Harbone (1973) was adopted. Five (5) of the sample was weighed into a 100ml beaker, 50ml of 10% acetic acid solution in ethanol was added and stirred. This was allowed to stand for 4h, filtered and the filtrate evaporates to ¼ of its original volume, and concentrated NH4OH was added drop wise to precipitate

the alkaloids. The precipitate was filtered off using a weighed filtered paper (W1) and washed with 1% NH4OH solution. The precipitate in the filter paper was oven dried at 600c for 30minutes and weighed (W2).The weight of alkaloid was determined by weight difference expressed as a percentage of the sample weight analyzed.

$$\% \text{ Alkaloid} = \frac{W2-W1}{W} \times \frac{100}{1} \quad \text{where:}$$

W = Weight of sample
W1 = Weight of empty filter paper
W2 = Weight of filter paper + precipitate.

Results and Discussion

Table 1 presents the antinutritional factors of raw and processed false yam tuber flour. The results are discussed below:

Table 1. ANTINUTRITIONAL FACTOR OF RAW AND PROCESSED FALSE YAM TUBER FLOUR (mg/100g)

Sample	Hydrogen cyanide (HCN)	Oxalate (Total)	Oxalate (soluble)	Tannin	Phytate	Alkaloid
RAW	0.53[a]	256.900[a]	98.25[a]	21.68[a]	3.85[a]	3.12[a]
SSD	0.255[c]	189.200[c]	74.800[d]	5.133[e]	2.037[c]	2.050b[c]
SOD	0.251[c]	184.800[c]	52.800[c]	20.815[c]	1.698[d]	1.950[c]
BOD	0.231[d]	167.200[c]	48.400[c]	16.511[d]	1.671[e]	2.165[b]
BSD	0.465[b]	244.400[b]	92.400[ab]	21.241b	2.274[b]	1.365[d]
LSD:	0.019	30.354	18.929	0.231	0.009	0.119

Abcde = means with similar superscript in the same column are not significantly different (P>0.05) from each other
SSD = Stepped sun dried flour sample
SOD = Stepped oven dried flour sample
BOD = Blanched oven dried flour sample
BSD = Blanched sun-dried flour sample

There was significant different (P<0.05) in hydrogen cyanide (HCN) contents between the raw sample and all other samples, but in "SOD" and "SSD' samples, there was no significant difference (P>0.05) in hydrogen cyanide (HCN) content. The raw sample had 0.53mg/100g HCN.
"BOD" had the least (0.231mg/100g). "SSD" and "SOD" had 0.255mg/100g and 0.251mg/100g respectively.
These values are low compared to 3.2 to 6.0mg HCN equivalent per kg fresh weight of wild yam tubers (Bhandari and Kawabata, 2004), 2.5mg/kg HCN for cassava flour + water; 19.4mg/kg HCN for soaked cassava roots; and 25.8mg/kg HCN for roasted garri (Bradbury and Holloway, 1988). This indicates that the HCN levels found in false yam are below the safety level of cyanide poisoning. The lethal dose range for humans, of HCN ingested is estimated to be only 0.5 to 3.5mg/kg – body weight (Brandbury, 1991) the normal range of cyanogens content of cassava tubers falls between 15 and 400mg HCN/kg fresh weight. The concentration varies greatly between varieties and also environmental and cultural conditions. The knowledge of cyanogenic glycosides content of food is vital because cyanide being an effective cytochrome oxidase inhibitor interferes with aerobic respiratory system. A lot of hydrocyanic acid is lost during soaking and cooking (Onwuka, 2005). There was no significant difference (P>0.05) in total oxalate in "SOD", "SSD" and "BOD" and "BSD" samples. "SSD" had 167.200mg/100g and 244.400mg/100g total oxalate respectively. The raw sample had 256.900mg/100g total oxalate. Equally, in soluble oxalate, there was significant difference (P<0.05) among the samples. The raw sample had 98.25mg/100g soluble oxalate. "BOD" had the least (48.400mg/100g) while "BSD" had (92.400mg/100g) soluble oxalate. Its acidic from (oxalic acid) is known to interfere with calcium absorption by forming in-soluble salt with calcium, thus making it unavailable for use by the body. The observed values are higher than those for some leafy vegetables, 24.65 to 46.22mg/100g (Chima and Igyor, 2007), wild yam tubers, 0.06 to 0.197mg/100g (Bhandari and Kawabata 2004). The lethal level of oxalate in man is 2 to 5g (Onwuka, 2005). The high content of calcium oxalate crystal, about 780mg/100g in some species of cocoyam, "Colocasia" and Xanthosoma, has been implicated in the acridity or irritation caused by cocoyam (Bradbury and Holloway, 1988). The acridity of high oxalate cultivars of cocoyam can be reduced by peeling, grating, soaking and fermenting during processing.
There was a significant difference (P<0.05) in tannin content among the samples. The raw sample had 21.68mg/100g tannin being the highest. The tannin content ranged between 5.144mg/100g to 21.68mg/100g, for the samples, with "SSD" having the least while "BSD" had 21.241mg/100g. "BOD" and "SOD" samples had 16.511mg/100g and 20.815mg/100g respectively. The observed range of values is higher than that for some tropical leafy vegetables, 0.32 to 0.83mg/100g (Chima and Igyor,2007), 0.044 ± 0.010mg/100g for water yam; 0.0047 ±0.20mg/100g for yellow yam; 0.09 ± 0.20mg//100g for biter yam; 0.5± 0.010mg/100g for white yam, and 0.08 ± 0.10mg/100g for aerial yam (Okwu and Ndu,2006).
Tannins inhibit the digestibility of protein. Phytate values for the samples ranged between 1.671 t0 3.85mg/100g, showing a significant difference (P<0.05) among the samples. The raw samples had 3.85mg/100g phytate. "BSD" Sample had 2.274mg/100g while "BOD" had the least (1.671mg/100g). The phytate levels are higher than those reported for bambara groundnut, 0.29%, pigeon pea, 0.2% (Igbedioh et al., 1994); wild yam tubers, 0.18 to 0.36% (as phytic acid) (Bhandari and Kawabata, 2004); yam 0.47%, cassava, 0.4% and maize 0.16% (Adeyeye et al., 2000).
Alkalods content showed a significant difference (P<0.05) among samples. The raw sample had 3.12mg/100g, which

is lower than that of African locust bean fruit pulp, 17.60gm/100g (Gernah et al., 2007). The observed values for the samples ranged between 1.36mg/100g to 3.12mg/100g, with "BOD" having 2.165mg/100g and "BSD' having the least, 1.365mg/100g. "SSD' and had 2.050mg/100g and 1.950mg/100g respectively. Also, the values obtained for the alkaloids contents of false yam were higher than those for some yam varieties, 0.74 ± 0.10mg/100g for water yam; 0.68 ± 0.02mg/100g for yellow yam; 0.88 ± 0.11mg/100g for aerial yam; 0.38 ± 0.12mg/100g for white yam (Okwu and Ndu, 2006). The alkaloid content of "BSD" sample (1.365mg/100g) is comparable with that of bitter yam (1.68 ± 0.01mg/100g).
Some of the toxicological manifestations of potato glycol alkaloids include gastro intestinal upset and neurological disorders, especially in doses in excess of 20mg/100g sample. Simple boiling removes the alkaloids present in most cultivated species of yams (Onwuka, 2005). The result of the antinutritional factors of false yam agree with the earlier statement by Okaka and Okaka (2005) that simple processes like soaking, fermentation and heating may be enough treatment to bring about improved wholesomeness of foods.

Conclusion

The study has shown that false yam, a root/tuber crop contains antinutritional factors like hydrogen cyanide, soluble and total oxalate, tannin, phytate and alkaloids. Some of these antinutritional factors were found to be below the lethal dose for human, and these antinutritional factors can be reduced to a level of non-toxicity if properly processed.

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