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Effect of Some Processing Methods on Selected Anti nutritional Factors of African Breadfruit (*Treculiaafricana*) Seed Flour

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Abstract

The effect of some processing methods on selected anti-nutritional composition of African breadfruit seed (*Treculia africana*) flour was investigated. Matured African breadfruit seeds were sorted, washed and drained. The drained seeds were dehulled manually. The anti-nutritional parameters determined were tannin, hydrogen cyanide, saponin, alkaloids and oxalate. The samples were divided into three portions of 600 g each. The first 600 g of the breadfruit seeds sample was subdivided into 200 g each and cooked for 1, 2 and 3 h respectively. The second portion was also subdivided into 200 g each and soaked for 6, 12 and 18hours respectively. The cooked and soaked samples were then dried in an oven set at 60^{o}C for 60 min. The remaining portion of 600 g was left raw to serve as control. All samples were milled and sieved into flour of particle size 1mm mesh. The flours were analysed for their anti-nutritional composition using standard methods. The results showed that the raw sample contained 3.20, 1.37, 2.49 and 0.35 mg/100 g of Hydrogen cyanide, Tannin, Saponin and Oxalate respectively and 4.00% of Alkaloids. There was a significant decrease ($P<0.05$) in anti-nutritional composition of the flour irrespective of the processing methods. Cooking for 3 h and Soaking for 18 h significantly ($P<0.05$) reduced hydrogen cyanide content to as low as 0.15 and 0.70 mg/100g respectively and reduced saponin to 0.38 and 0.63 mg/100 g respectively. Tannin and Oxalate were reduced to 1.55 and 1.65; 0.15 and 0.18 mg/100 g respectively using the two processing methods. Alkaloids also reduced to 1.38 and 1.51 %. It was concluded that either of the processing methods used in the study can be used as a safe processing method for African breadfruit seed as they both drastically reduced the anti-nutrients available in the raw seed.

Keywords: African breadfruit seed flour, Alkaloids, Saponin, Soaking, Tannin

1. Introduction

There is increased awareness of the importance of legumes in the diet of Nigerian populace. The main contribution of legumes to the diet of Nigerians is based on their nutritional values, especially their contribution of proteins. African bread fruit (*Treculia africana*) is one of mankind's important sources of nutrients such as vitamins, carbohydrates, minerals, proteins and fat. It is a very important indigenous fruit which generally play a vital role in the diet of man (Ejiofor, Obianuju and Okafor, 1998).

African breadfruit (*Treculia africana*) is a monoecious evergreen tree belonging to the family of *Moraceae*. It is widely grown in the tropics and yield fruit with edible seeds. About fifty species of *Treculia africana* are known to grow in the hot moist region of the Southeast

Asian tropics. The seed production of African bread fruit is considerable; a mature tree produces up to 30 fruits annually, each fruit yielding 5 – 10 kg of seed after processing (Kabuo, 2001). The fruits are hung on the stem and branches and take about four months to mature. It is a grain legume which is a source of many vital food nutrients. It contributes immensely to the diet of Nigerians (Iwe and Ngoddy, 2001). The seed resembles the groundnut in flavour and uses and it may be processed into flour apart from being cooked and eaten as a main dish (Nwafor and Mba 1988).

African breadfruit is native to Tropical African and some other countries in West Indies (Kabuo, 2001). The raw seed as well as the edible cotyledon are processed by parboiling and dehulling. According to Kabuo (2001), African breadfruit contains some essential amino acids (EAA) he, however reported that it requires sulphur containing amino acid (cystine, methionine) to produce a desirable pattern of EAA. African breadfruit '*Ukwa*' in Igbo Language is mostly cherished, consumed and utilized in Igbo land and other parts of the Southern States of Nigeria. In other parts of Nigeria, the crop is not widely cherished due to ignorance of its nutritional potentials, processing and utilization (Ajiwe, Okeke and Agbo, 1995). Breadfruit seeds are used to prepare various traditional dishes. They could be roasted, consumed with soups, pound, boiled or mashed to make pottage.

The *Treculia africana* fruit is extracted to obtain the edible seeds, which are nutritious when cooked and consumed (Ejiofor *et al.,* 1998). The seeds are known to contain some anti nutrients which interferes with the absorption and digestion of the nutrients in man (Ekpenyong, 1985).The ultimate goal of processing, however, is to preserve the nutrients in order to make them available to the consumers and to remove or reduce the levels of phytochemicals which interfere with nutrient digestion and absorption. Ekpenyong (1985) reported that the poor shelf life of *Treculiaafricana* limits its use in the diet, regardless of its known carbohydrate and lipid content. The aim of this study was to evaluate the effect of cooking and soaking on some anti-nutritional factors ((*tannin, hydrogen cyanide, saponin, alkaloids and oxalate*) of African breadfruit seed flour which if not removed or reduced may lead to inadequate utilization of essential nutrients available in the flour .

2. Materials and Methods

2.1 Materials

The breadfruit variety used for this study was obtained from Relief Market in Owerri Municipal L.G.A, Imo State, Nigeria. The reagents and chemicals used for the various analyses were of analytical grades. Equipment and utensils used were obtained in the Department of Agricultural and Bio-resources Engineering, Federal University of Technology Minna, Niger State, Nigeria.

2.2 Methods

African breadfruit seeds were sorted, washed and drained. The drained seeds were dehulled manually to obtain a full fat dehulled breadfruit seed. With the initial anti nutritional factors (tannin, hydrogen cyanide, saponin, alkaloids and oxalate) determined, the samples were divided into three portions, with each portion containing six hundred grammes (600 g) of the breadfruit seed samples. The experiment was carried out using a 2 by 3 Completely Randomized Block Design (2 treatments x 3 time durations x 3 replicates =18). Data collected were analyzed statistically using the SPSS 16.0 statistical package, with analysis of variance based on t- test method.

2.2.1. Preparation of Cooked Breadfruit Seed Flour Sample

Exact quantity 600 g of dehulled African breadfruit seeds was weighed and subdivided into two hundred grammes (200 g) each and poured into three steel pots containing two litres of distilled water each which were then placed on a magnetic hot plate for cooking. The first sample was cooked for one hour; second sample was cooked for two hours and the third sample was cooked for three hours respectively. The breadfruit seeds were drained, oven dried at 60°C for 60 min, milled and passed through a sieve of mesh size 1mm. The dried seed flour were packaged in high density polythene film, sealed and taken to the laboratory for further analysis.

2.2.2 Preparation of Soaked Breadfruit Seed Flour Sample

Exact quantity 600 g of dehulled African breadfruit seeds was weighed and subdivided into two hundred grammes (200 g) each and poured into three containers containing two litres of distilled water each and allowed to soak. The first sample was soaked for six hours; the second sample was soaked for twelve hours, while the third sample was soaked for eighteen hours respectively. The breadfruit seeds were drained, oven dried at 60°C for 60 min, milled and passed through a sieve of mesh size 1mm. The dried seed flour were packaged in high density polythene film, sealed and taken to the laboratory for further analysis.

2.3 Anti-Nutritional Composition Determination

The anti-nutritional compositions which include hydrogen cyanide, tannin, saponin, alkaloid and oxalate contents were determined according to the method described by the Association of Official Analytical Chemists (2000).

3. Results and Discussions

The result of the anti nutritional factor analysis carried out on the breadfruit seeds samples showed that there were significant differences ($P<0.05$) between the raw breadfruit seeds (control sample) and processed samples in all the anti-nutritional factors (tannin, saponin, hydrogen cyanide, alkaloids and oxalate) (Table 1). This could be attributed to the effects of the processing methods.

The tannin content of the raw breadfruit seeds (control) sample was highest (3.20 mg/100 g while the processed breadfruit seeds samples had lower tannin contents which ranged from 1.55 to 1.74 mg/100 g. The range of values obtained for the processed samples (1.55 - 1.74 mg/100 g and 1.65 – 1.78 mg/100 g) falls within the range of values (0.35 – 3. 20 mg/100 g) reported by Nwaigwe and Adejumo (2015). The tannin content (3.20 mg/100 g) of the raw breadfruit seeds sample reported in the present study was higher when compared with the value (0.14 %) reported by Ijeh, Ejike, Nkwonta and Njoku (2010) but lower than the value of 26.45 mg/100 g reported by Ugwu and Oranye (2006). The differences observed in the tannin contents of these raw breadfruit seeds samples could be attributed to the species or variety of African breadfruit seed used. The reduction observed could be as result of leaching and/or the effect of the heat on the heat liable tannins contained in the breadfruit seeds samples. This agrees with the fact that tannins are polyphenols and polyphenolic compounds which are soluble in water, and are mostly located in the seed coat and therefore their reduction during soaking and cooking may be attributed to leaching out of the phenol. Ikemefuna, Obizoba and Atii. (1991) also reported that soaking and fermentation decreases the tannin content in legumes.

Table 1: Effect of Processing Methods on some Anti nutritional Compositions of African Breadfruit Seed flour

Treatment	Tannin (mg/100g)	Cyanide (mg/100g)	Saponin (mg/100g)	Alkaloid (%)	Oxalate (mg/100g)
Rw	3.20^{a}±1.00	1.37^{a}±0.16	4.49^{a}±1.03	4.00^{a}±1.00	0.35^{a}±0.08
C1	1.74^{b}±0.19	1.11^{a}±010	1.31^{b}±0.05	3.63^{ab}±1.00	0.24^{b}±0.02
C2	1.68^{b}±0.19	0.40^{c}±0.03	0.41^{c}±0.16	2.26^{b}±1.00	0.17^{c}±0.07
C3	1.55^{c}±0.10	0.15^{d}±0.01	0.38^{c}±0.03	1.38^{c}±1.00	0.15^{c}±0.01
S6	1.78^{b}±0.30	1.19^{a}±0.30	1.41^{b}±0.11	3.67^{ab}±1.00	0.27^{b}±0.05
S12	1.68^{b}±0.43	1.01^{ab}±0.14	1.07^{bc}±0.31	3.12^{b}±1.00	0.19^{c}±0.03
S18	1.65^{b}±0.33	0.70^{b}±0.04	0.63^{c}±0.06	1.51^{c}±1.00	0.18^{c}±0.06

Means are duplicate determination; values with same superscript along the column are not significantly different

Key: Rw=Raw, C=Cooked, [1, 2, 3 hours], S=Soaked [6, 12, 18 hours]

The value of the hydrogen cyanide content of the raw breadfruit seeds samples (1.36 mg/100 g) obtained from this study was higher than the value of 0.06 mg/100 g reported by Osabor, Ogar, Okafor and Egbung. (2009); lower than the value of 1.49 mg/100 g reported by Nwaigwe and Adejumo (2015) but agrees with the value of 1.34 mg/100g reported by Olapade and Umeonuorah (2013). The differences observed may be due to the species or variety of African breadfruit seed used. There were significant differences (P<0.05) in the hydrogen cyanide content of the processed samples as they drastically reduced. When they were soaked for 6, 12 and 18 hours, hydrogen cyanide contents of the samples reduced to 1.11, 0.40 and 0.15 mg/100g respectively; when cooked for 1, 2 and 3 hours, the hydrogen cyanide contents reduced to 1.19, 1.01 and 0.63 mg/100g respectively. These trends compare favourably with the results reported by Nwaigwe and Adejumo (2015) (1.39 – 0.48 mg/100g) and Olapade and Umeonuorah (2013) (1.08 – 0.01%) for hydrogen cyanide content of African breadfruit. Hydrogen cyanide was highest (1.37 mg/100g) in the raw breadfruit seeds sample and lowest (0.15 mg/100g) in the sample cooked for 3 hours.

Saponin content was highest (2.49 mg/100 g) in the raw breadfruit seed samples while the processed samples had lower saponin contents of between 0.15 and 1.19 mg/100 g. The value of the saponin content of the raw breadfruit seeds samples (2.49 mg/100 g) obtained from this study is greater than the value (0.47%) reported by Olapade and Umeonuorah (2013). The breadfruit seed samples soaked in water for 6, 12 and 18 hours had saponin contents of 1.41, 1.07 and 0.63 mg/100 g; while those cooked for 1, 2 and 3 hours had saponin contents of 1.31, 0.41 and 0.38 mg/100 g respectively. The reduction observed could be as result of leaching of the breadfruit seeds samples. It was observed that saponin present in the raw breadfruit seeds sample was reduced to minimal level when soaked and cooked with the different time durations. Saponins are not always destroyed during cooking. However, Onimawo and Akubor (2005) reported that trace elements of saponins are nutritionally beneficial because of their hypocholestorolemic activity (cholesterol lowering).

There were significant (p< 0.05) differences in the alkaloid content of all the samples, irrespective of the processing method and duration. The alkaloid contents of the raw and processed breadfruit seed samples ranged between 1.38 and 4.00%, with cooking for 3 hours having the lowest mean value of 1.38%. The alkaloid constituents of the African breadfruit seed reported in this present study is similar to that reported by Nwaigwe and Adejumo (2015) (1.33 – 4.00 %); they reported that thermal processing significantly decreased the alkaloid content of African breadfruit. Alkaloids, including oxalates, are commonly found in legumes and often result in bitter taste and flatulence in humans. Low level of these anti nutrients would reduce flatulence in humans.

The oxalate content of the raw breadfruit seeds sample (0.35 mg/100 g) was lower than the values (3.01 and 3. 23 mg/100 g) reported for raw *Treculia Africana* seeds by Osabor *et al*. (2009) and Nwaigwe and Adejumo (2015). The samples soaked in distilled water for 6, 12 and 18 hours were found to have oxalate contents of 0.27, 0.19, and 0.18 mg/100 g respectively. While the samples cooked for 1, 2 and 3 hours had oxalate contents of 0.24, 0.17, and 0.15 mg/100 g respectively. The decrease in the value of the oxalate contents of the processed breadfruit seeds samples could be attributed to the leaching out of oxalate in the processing water. It could also be that some oxalate had been destroyed by long duration of cooking (3 hours). Nwosu, Owuamanam, Onuegu, Ogueke and Ojukwu . (2012) reported that processing of African yam bean (*Sphenostylis sternocarpa*) had effect on the anti-nutritional properties of this bean.

4. Conclusion

This study has shown that processing African breadfruit seed under longer duration had positive effect with respect to its anti-nutritional properties irrespective of the processing methods used. The two methods used in this study; cooking and soaking; are both suitable for the safe processing of African breadfruit seed as both methods helped to reduce the anti -nutrients, thereby enhancing the nutritional composition of the raw breadfruit seeds. Thus, either of the processing methods used in the study can be safely used as a processing method for African breadfruit seed as they both drastically reduced the anti-nutrients available in the raw seed.

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