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Effects of Processing on the Chemical and Anti-nutritional Properties of Cassava Roots.

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Research Article

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ABSTRACT

The nutritive and antinutritive composition of cassava roots (raw and boiled) was investigated. The proximate composition of raw and boiled cassava tubers was not significantly different (P> 0.05), except in moisture, fat, carbohydrate and Energy value. High levels of the antinutrients in raw cassava tubers (20.56mg/100g Tannins; 1,16mg/100g oxalate and 3.36mg/100g phytate) make them unsafe and unsuitable for human consumption except after processing. Mineral contents of cassava tubers were not affected significantly by boiling except in Iron. Calcium was the most abundant mineral present (0.33% and 0.26% for raw and boiled cassava roots) and the low Ca/P ratio of 6.19 in boiled cassava roots will facilitate calcinations of calcium more than the raw cassava roots with a Ca/P ratio of 8.68.

INTRODUCTION

Cassava (*Manihot esculenta crantz*), an important staple in the tropics, is grown in increasing amounts per capital [1] . However, cassava utilization has been limited by the extreme perishability of the fresh roots when stored. This is due to the high moisture content of cassava tuber which is 65%-70% on dry weight basis [2]. Cassava toxicity is another limiting factor in the use of the tuber. The inherent Cyanogenic glucosides upon hydrolysis yields hydrocyanic acid which is toxic to humans in high concentrations [3].Cassava has gained increased industrial, economic and nutritional importance over the years, because of the multifarious uses of the starch – rich tubers or roots [4] . For example, the roots of cassava can be baked to make garri. As cassava flour, it could be prepared in boiling water as “eba” taken with a variety of vegetable soup. Apart from composite flour for bread making, cassava flour is used in the making of noodles, biscuit and confectionaries [5, 6] . Its starch is used as glue and adhesives in textile and pharmaceutical industries while it is converted by hydrolysis action and utilized in ethanol distilleries [5].

Cassava has found modern use as fuel and the roots of cassava are used as roughages for animal feed, because of its high fibre content mainly for herbivorous animals [3]. The proximate compositions of some varieties of cassava have been determined by earlier workers [6]. About 10% of world production of cassava is used in the manufacture of industrial starch and starch products. Cassava starch is used in the production of citric acid, monosodium glutamate, sorbitol, mannitol, glucose, high fructose syrup and alcohol. There have been efforts to produce new products such as bread, biscuit and cakes from cassava flour [7]. Some of these products are not in acceptable edible forms yet and the prospect of some of these products challenging wheat flour products in the nearest future is remote.

Cassava is mainly a starchy food [8, 9]. The chemical composition of the root varies depending on some factors such as age of the plant, variety, climatic conditions and cultural practices [10] . The cassava root has an average composition of 60%- 65% moisture, 30% - 35% carbohydrate, 0.2% -0.6% extractives, 1%-2% crude protein, 0.3%-1.3% ash, 0.8%-1.3% fibre [11] and vitamin C is found in an appreciable amount [12]. Cassava also provides minerals including relatively high amount of calcium and iron which are found in higher qualities in some product such as grain than in the raw root [13] . Cassava is not only poor in protein but the protein is deficient in the essential amino acids [14] . It is important therefore, to determine the effect of processing especially, boiling, on the nutritive and antinutritive properties of a high cyanide cassava cultivar [TMS 30572]. Cassava is widely used as human feed, livestock feed and various forms of industrial uses [15] .About 90% of the world production is utilized as food [16] . It is an important source of carbohydrate [17] . As food for man, cassava root is prepared in many ways such as boiled, baked or fried and many product are formed which include garri [west Africa], fufu [Nigeria, Ghana,Zaire], kokonte and attieke [Ivory coast], Oyoko [Zaire] and lafun [Nigeria] [17] . There is an increase in the use of cassava for industrial fermentation for alcohol production [13] and for microbial protein production for animal feed [18] . This work therefore was aimed at determining the proximate composition, mineral contents and antinutrients in both raw and boiled cassava roots.

MATERIAL AND METHODS

Collection and Processing of cassava tubers

The cassava tuber (TMS 30572 cultivar) were harvested from the experimental farm of Rufus Giwa Polytechnic, Owo, Ondo State.One kilogram of the cassava tubers was boiled with water in a metallic pot for 1 hour before it was homogenized in a warring mechanical blender. The raw cassava tubers and the boiled cassava tubers were then subjected to different analysis.

Determination of Proximate composition

The proximate composition of the cassava roots (raw and boiled) was determined by using the standard methods of [19] .

Determination of the Energy value

The energy values of the cassava roots was calculated using the method of [20]. This was done by multiplying the value of crude protein, fat and carbohydrate by factors of 4, 9 and 4 respectively.

Determination of Mineral content

Mineral content of the samples were determined by drying ashing extraction method of [21] .

Determination of Anti-Nutritional

The anti nutritional factors (tannins, oxalate and phytate) of the cassava roots were determined by the method of [22] .

RESULTS AND DISCUSSION

Results of the proximate composition of raw and cassava tubers were shown in table 1. There was no significantly difference in the ash, protein and crude fibre contents in the raw and boiled cassava tubers, but, moisture and fat levels were significantly higher in the raw than in the boiled cassava tubers. However, boiling significantly increased the carbohydrate and energy levels of cassava tubers from 30.63% and 129.71kcal to 36.82% and 151.95kcal respectively. The proximate composition of the boiled cassava tubers was slightly lower in the boiled tubers than in the raw tubers, probably due to leaching. [23] reported that boiling or heat processing might rescue some nutrients in food samples. The ash contents obtained from this study [1.05% and 0.76% for raw and boiled tubers] were lower than the recommended ash content range of 1.5-2.5% for nuts, seeds and tubers in order to be suitable for animal feeds [24] . The crude fibre content of the raw and cassava tubers [1.11% and 1.17% respectively] were low compared to other crops like legumes with mean values ranging between 5-6% [14]. Crude fibre helps in the maintenance of normal peristaltic movement of the intestinal tract hence; diets containing lower fibre could cause constipation, and eventually lead to colon diseases [25] . The values obtained for carbohydrate [by difference] [36.63% and 36.82% for raw and boiled tubers respectively] .Its an indication that the raw and boiled cassava tubers are rich sources of energy and capable of supplying the daily energy requirements of the body [26] . The calculated metabolizable energy value of boiled cassava tuber [151.95kcal] is significantly higher than that in the raw cassava tuber [129.71kcal]. This implies that cassava tubers are a good source of energy.

Table 2 presents the mineral content of the raw and boiled cassava tubers. There was no significant difference in the sodium, magnesium, calcium and phosphorus contents in the raw and boiled tubers but iron level was significantly higher in the raw tubers. The most abundant of the minerals was calcium followed by magnesium, phosphorus and Iron in that order. These results were in close agreement with what was reported by [16] . Magnesium has been reported to be involved in maintaining the electrical potential in leaves and activation of some enzyme systems [27] . Also, calcium is responsible for bone formation in conjunction with phosphorus, magnesium, manganese, vitamin A, C and, chlorine and protein [28] . Boiled cassava tubers with a lower Ca/P ratio of 6.19 will facilitate calcinations of calcium more than the raw cassava tubers with a Ca/P ratio of 8.68.

The Antinutrients quality of raw and boiled cassava tubers were shown in table 3, there were significant differences in the antinutrients [tannins, oxalate and phylate] determined in this study. The raw cassava tuber was significantly higher in antinutrients than boiled cassava tubers, such as tannins, oxalate and phylate. Hence, consumption of raw cassava tubers may be detrimental to humans, since it could result in neurotoxicity and neuropathy [29] . As observed in this study, boiling significantly reduced the levels of the Antinutrients. Hence, it is imperative to suggest that cassava tubers should be properly processed before consumption, by either boiling, steeping, roasting or soaking in water for a period of time .[30][4] reported a decrease in antinutritional factors of sorghum during, soaking, probably due to leaching into the soaking water [29] . The determination of the antinutrients was of interest due to their negative effects on mineral bioavailability and poor growth [16] . The antinutrients contents in the raw cassava tubers from this study, were higher than the recommended limits [1] . Therefore, they are unsuitable or unsafe for consumption.

Table 1: Proximate composition of Raw and boiled cassava tubers

Proximate Composition	Raw Tuber	Boiled Tuber
Moisture [%]	66.96±2.018^{a}	61.39±2.98^{b}
Ash [%]	1.05±0.02^{a}	0.76±0.03^{a}
Fat [%]	0.35±0.03^{a}	0.10±0.01^{b}
Protein [%]	1.01±0.04^{a}	0.92±0.03^{a}
Crude fibre [%]	1.11±0.04^{a}	1.17±0.03^{a}
Carbohydrate [%]	30.63±1.21^{b}	36.82±2.01^{a}
Energy value [kcal]	129.71±4.13^{b}	151.95±5.62^{a}

(Values expressed as mean ± S.D of triplicates while those with different superscripts horizontally were significantly [P<0.05] different.)

Table 2: Mineral composition of Raw and Boiled Cassava Tuber.

Mineral [%]	Raw Tuber	Boiled Tuber
Sodium	0.06±0.003^{a}	0.08±0.001^{a}
Magnesium	0.08±0.001^{a}	0.07±0.002^{a}
Calcium	0.33±0.02^{a}	0.26±0.03^{a}
Iron	0.0017±0.0002^{a}	0.0013±0.0006^{a}
Phosphorus	0.038±0.004^{a}	0.042±0.004^{a}

(Values expressed as mean ± S.D of triplicates while those with different superscripts horizontally are significantly [P<0.05] different).

Table 3: Anti- nutrients Quality of Raw and Boiled Cassava Tubers

Antinutrients [mg/100g]	Raw Tubers	Boiled Tubers
Tannins	20.56±1.31^{a}	9.96±1.69^{b}
Oxalate	1.16±0.07^{a}	0.79±0.007^{a}
Phylate	3.36±0.07^{a}	0.79±0.007^{b}

(Values expressed as mean ± S.D of triplicates while those with different superscripts horizontally are significantly [O< 0.05] different).

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CONCLUSION

The results from this study showed that processing is needed before cassava roots could be consumed as shown by the nutritional and antinutritional qualities of both raw and boiled cassava roots.

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