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Effect of Blanching Time on the Beta-Carotene and some Chemical Composition of *Abacha* from Yellow Fleshed Cassava Varieties

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Abstract

This research studied the effect of blanching time (5, 10 and 15 min) on β-carotene, cyanide, mineral (Zn, Fe, K) and vitamin (B_1, B_2, C) composition of *Abacha* from three yellow fleshed cassava varieties (UMUCASS 44, UMUCASS 45, UMUCASS 46). The cassava samples were freshly harvested from the research farm of National Research Institute and were processed into *Abacha* chips by following standard method for *Abacha* processing. The β-carotene values ranged from 0.89-5.81μg/g with UMUCASS 44 having the least β-carotene value (0.89 μg/g) and UMUCASS 46 having the highest β-carotene value (5.81 μg/g). The cyanide content ranged from 1.51-4.28 mg/kg suggesting that all the *Abacha* samples were lower than the WHO bench mark of <10 mg/kg. The zinc content ranged from 0.75-1.31mg/100g, while Iron content ranged from 1.45-2.18 mg/100g. It was observed that the ppotassium contents were within the range of 65.77 to 174.88 mg/100g. The values for vitamin B_1 had least value of 0.03mg/100g and a highest value of 0.31 mg/100g; while vitamin B_2 ranged from 0.10-0.505 mg/100g. The vitamin C content of the *Abacha* chips ranged from 4.46-25.08 mg/100g. All the *Abacha* samples were safe when considering their cyanide content but UMUCASS 46 produced the safest *Abacha* sample at 5 min hot water blanching having a cyanide content of 1.51 mg/Kg. From the data generated, safe *Abacha* samples could be produced from yellow fleshed cassava varieties at minimal energy cost.

Keywords: *Abacha*, β-carotene, cassava, cyanide, UMUCASS 44/45/46

Introduction

Cassava (*Manihot esculenta* Crantz) is a dominant staple (a primary source of food for a large portion of the Nigerian population) of importance in many developing countries of the humid and sub-humid tropics in Africa and other parts of the world (Kacou *et al.*, 2018). The different varieties of cassava have been noted, and has slight variations in their tuberous nutritional quality (Abok *et al.*, 2016). Nigeria is the largest producer of cassava in Africa and accounting for about one-fifth of the global production. In the year 2021 alone, Nigeria produced over 63 million tons of cassava tubers (Josephine, 2023).

Madubuike *et al.* (2014) reported the proximate composition of a cassava specie from *Ohaukwu* community in Ebonyi State Nigeria as follows: crude protein (0.96%), moisture (5.00%), carbohydrate (83.84%), crude fibre (7.60%), ash (2.00%), and lipids (0.60%). Its cyanide content was 1.91 mg/kg, while the mineral elements composition were as follows: Ca(0.28mg/kg), Cu(1.49mg/kg), Mn(6.20mg/kg), Mg(0.50mg/kg), Na(0.04mg/kg), Fe(7.88mg/kg), Zn(10.01mg/kg), Pb(0.25mg/kg), Cd(0.006mg/kg) and K(5.28mg/kg). In southeast Nigeria alone, Salau *et al.* (2019) reported about 80% of the population eats cassava and cassava-based products on a daily basis providing over 70% of daily calorie intake. Nutritional deficiencies associated with cassava include: Vitamin A Deficiency, Calcium, Phosphorus, Molybdenum, Iron, Zinc Deficiency and Protein Deficiency (Gegios *et al.*, 2010). Okwuonu *et al.* (2021) has reported a strong positive correlation on the micronutrient deficiency and consumption of cassava in Nigeria, affecting an estimated 6 million children under five years old. Thus improvement/ fortification of cassava would benefit a large segment of the Nigerian population.

Fortification is the practice of deliberately or intentionally increasing the content of a target micronutrient. This micronutrient could be a vitamin(s) or mineral(s) (Olson *et al.*, 2021). Furthermore, bio-fortification is the process by which the nutritional quality of food crops is improved either by conventional plant breeding or by agronomic practices or by transgenic approaches (Garg *et al.*, 2018).

Research has shown that bio-fortification of staple crops with pro-vitamin A (carotenoid) is an emerging strategy that significantly improve the nutritional profile of food stuffs intended to address the vitamin A status of the poor or average class that uses cassava product to prepare staple meals (Drapal and Fraser, 2019; Jha and Warkentin, 2020). Carotene is a retinol (vitamin A) precursor which reduces the risk of age-related macular degeneration, cataract, osteoclastogenesis, and coronary heart diseases (Akram *et al.*, 2021).

The *Abacha* is a Nigerian delicacy made from cassava chips that is often enjoyed as a, appetizer, dessert, full meal or snack (Thomas and Oriaku, 2010). *Abacha* is a nutritious and delicious delicacy that is also popularly called African salad (Dike *et al.*, 2021). It is made using dried shredded cassava which is soaked in water to soften it a little bit. The dried shredded cassava is obtained from cassava tubers, cut with a knife into small pieces, boiled, and dried in the sun (Dike *et al.*, 2021).

This work studied the preparation of *Abacha* from three fleashly harvested biofortified cassava varieties and the effect of blanching using boiling hot water at various time (5, 10, 15 min) on the beta-carotene content, mineral and vitamin (B_1, B_2, C) composition of the *Abacha* chips.

Material and Methods

Sample collection

Fresh roots of three yellow root varieties namely: UMUCASS 44, UMUCASS 45 and UMUCASS 46 were obtained from the Cassava Programme of NRCRI, Umudike. All the cassava roots were harvested at 11 months after planting.

Experimental Design

A 3x3 factorial experiment was used to study the responses of the experimental variable (blanching time) on the beta-carotene content, mineral and vitamins (B_1, B_2, C) composition of the *Abacha* chips as shown in Table 1. The duplicates of each response was used to obtain respective means which was analysed using one way analysis of variance (ANOVA) and difference between means were separated using the Duncan's Multiple Range Test. All statistics analysis were carried out using the Statistical Package for Social Sciences (SPSS) version 22 at a significant level of $P<0.05$.

Production of Cassava Chips (*Abacha*)

The freshly harvested cassava roots were manually peeled with a sterile stainless steel knife, washed and cut into chunks (7.0 – 8.0 cm length) and then boiled in water for 5, 10, 15 min, respectively. The cooked samples were cooled, thinly shredded (0.50 – 0.80 mm thick), washed and then soaked in potable water at room temperature for 72 h. The soak water was drained and replaced after every 12 h to obtain fresh wet cassava chips. The fresh wet cassava chips were sun-dried until it became brittle to obtain dried cassava chips.

Table 1: Experimental design showing independent variables

	Pro vitamin A Cassava Varieties		
Blanching Time (Min)	UMUCASS 44	UMUCASS 45	UMUCASS 46
5	CSD	NPC	UZU
10	XYZ	SDP	LPA
15	VTU	UMUM	OPT

(Cassava Root)
↓
Cutting (5 cm) using a sterile kitchen knife
↓
Peeling
↓
Washing (with potable water)
↓
Preheating (100°C for 5, 10 and15 mins)
↓
Cooling (45^{O}C)
↓
Shredding (kitchen type)
↓
Soaking (72 h with Intermittent Change of potable water at room temperature)
↓
Sun-Drying (Constant Weight)
↓
(*Abacha*)

Fig. 1: Production of *Abacha* chips

Determination of Ascorbic acid content

The method used was as described by Okwu and Josiah (2006). Ten (10) grams of the sample was extracted with 50 mL ethylenediaminetetraacetic acid (EDTA) solution for 1h and filtered through a Whatman filter paper into a 50mL volumetric flask. This was made up to the mark with the extracting solution. Twenty (20) mL of the extract was pipetted into a 250 mL conical flask and 10 mL of 30% potassium iodide (KI) was added and also 50 mL of distilled water added. This was followed by 2 mL of 1% starch indicator. This was titrated against 0.01 M copper sulfate ($CuSO_4$) solution to a dark end point.

Vitamin C (mg/100g) = $0.88 \times \frac{100}{5} \times \frac{vf}{20} \times \frac{T}{1}$

Where: Vf = Volume of the extract
T = Sample titre - blank titre

Determination of Mineral Content

The following minerals (potassium, iron, zinc) were analysed using the method as described in FAO (2015). Two (2) g of sample was added to 100ml beakerthat contained 10ml distilled water, while 20 ml of aqua Regia was added for digestion. The sample was place on a water bath at 80ºC and heated for 1 h before the sample was brought down and allowed to cool, while 10ml of distilled water was added. The sample was filtered and made up the filtrate to 100 ml in a 100 ml volumetric flask.Using an atomic absorption spectrometer (AA 500F by PG Instrument Ltd, Alma Park Wibtoff, Lutterworth UK), the concentration of the various minerals were read off, using the following wavelength, Potassium-766.5nm; Iron-248.3nm; Zinc-213.9nm.

Determination of pro-vitamin A (*β-carotene*)

The method used by Ukom *et al*. (2023) was used in the determination of vitamin A content. The *Abacha* samples (5g) were extracted with cold acetone and then partitioned with petroleum ether. The aqueous phase was discarded after partitioning and the petroleum ether phase was washed three times to remove residual acetone. It was passed through a funnel containing anhydrous sodium sulphate to remove residual water and the absorbance was at 450nm using a spectrophotometer. Twelve (12) µg β-carotene as 1µg retinol activity equivalents was used to calculate vitamin A content.

ß carotene content (µg/g) = $\frac{A \times \text{Volume(ml)} \times 10000 \times df}{A1\%tcm \times \text{weight of sample}}$

A = Absorbance
V =Total volume of extract
$A^{100\%}$ tcm = Absorbance coefficient of β-carotene in petroleum ether (2592)

Determination of Hydrogen Cyanide (HCN)

This was determined by the alkaline picrate colorimetric method of Bradbury *et al.* (1999). One gram of each sample was weighed into a conical flask and 200 ml of distilled water added to it. Each sample was thoroughly mixed. A strip of alkaline picrate paper was suspended over the mixture, with the aid of a rubber stopper, in such a way that the paper did not touch the surface of the mixture. The set up was incubated for 18 h at room temperature. At the end of the incubation period, the picrate paper was carefully removed and placed in 60 ml of distilled water. Meanwhile a standard cyanide solution was prepared and treated as described above. The absorbance of elute from the standard and the sample were measured in a spectrophotometer at 540 nm. The cyanide content (HCN) in mg/Kg was calculated using the formula:

HCN (mg/Kg) = (100/W) x Au (As)
Where W = weight of sample analysed (g)
Au = Absorbance of sample (nm)
As = Absorbance of the standard HCN solution (nm)

Results and Discussion

The result of the Vitamin B_1, B_2 and C of the *Abacha* samples are reported in Table 1. The Vitamin B_1 (thiamine) content ranged from 0.03 to 0.27mg/100g, and the varieties and blanching time produced samples that were significantly different ($p< 0.05$). Samples from UMUCASS 44 variety showed increased vitamin B_1 content as preheating time was extended. Similarly, samples from UMUCASS 45 had increased Vitamin B_1 values due to prolonged increase preheating times, but the increase was more significant compared to UMUCASS 44, although preheating time above 10 min appeared to have a destructive effect on the vitamin B_1 content. The samples produced from UMUCASS 46 showed different trend as the Vitamin B_1 value remained relatively constant across different preheating times, with a preheating time of 10 min having the highest vitamin B_1 content of 0.27 mg/100g. When comparing the mean values, it was evident that the preheating time had a significant effect ($p<0.05$) on the Vitamin B_1 values across the different cassava varieties. Sample processed from UMUCASS 45 had the highest mean Vitamin B_1 value of 0.16 mg/100g, followed by UMUCASS 44 with a mean value of 0.113 mg/100g, and UMUCASS 46 with a mean value of 0.12 mg/100g.

On the other hand, samples processed from UMUCASS 44 showed a decrease in the mean Vitamin B_2 value from 5 min (0.17 mg/100g) to 10 min (0.135 mg/100g), and then an increase at 15 min (0.25 mg/100g). However, the overall mean value (0.175 mg/100g) suggests a relatively stable Vitamin B_2 content. For UMUCASS 45, there is a significant increase in the mean Vitamin B_2 value from 5 min (0.19 mg/100g) to 10 min (0.505 mg/100g), followed by a decrease at 15 min (0.105 mg/100g). The overall mean value (0.266 mg/100g) indicates a relatively higher Vitamin B_2 content compared to the other varieties. For sample produced from UMUCASS 46, there is a slight increase in the mean Vitamin B_2 value from 5 min (0.10 mg/100g) to 10 min (0.38 mg/100g), and then a decrease at 15 min (0.155 mg/100g). The overall mean value (0.2116 mg/100g) suggests a moderate Vitamin B_2 content. Based on these observations, we can conclude that the different preheating times had varying effects on the Vitamin B_2 value of the cassava varieties. *Abacha* samples produced from UMUCASS 45 showed a significant increase in Vitamin B_2 content at 10 min of preheating compared to the other varieties.

The results shows that *Abacha* samples produced from UMUCASS 44, 45, 46 had significant effect on the vitamin C content when heated after 10 min had the highest positive effect for all the samples with *Abacha* samples from UMUCASS 45 having the highest vitamin C content of 25.10 mg/100g followed by samples from UMUCASS 46 with vitamin C content of 8.28 mg/100g and lastly samples from UMUCASS 44 with vitamin C content of 7.73 mg/100g. This experiment suggests that preheating for 10 min favours vitamin C retention.

Mineral composition of blanched *Abacha* from yellow root cassava varieties

The mineral composition of blanched *Abacha* from Yellow Root Cassava varieties was shown in Table 2. The zinc content of UMUCASS 44 ranged from 0.7 to 1.3 mg/100g, while the zinc content of UMUCASS 45 ranged from 0.7 to 1.3mg/100g. The zinc content of UMUCASS 46 ranged from 0.8 to 1.2 mg/100g.

Table 1: Effect of Blanching time on Vitamin B1, B2 and C composition of *Abacha* from yellow flesh cassava varieties

Variety	Vit. B_1 **(mg/100)**	Vit. B_2 **(mg/100g)**	Vit. C **(mg/ 100)**
UMUCASS 44			
5 min	0.03^{d}	0.17^{de}	5.17^{f}
10 min	0.10^{c}	0.14^{ef}	7.73^{d}
15 min	0.21^{b}	0.25^{c}	4.45^{h}
Mean	***0.11***	***0.18***	***5.78***
UMUCASS 45			
5 min	0.13^{c}	0.19^{d}	7.61^{e}
10 min	0.31^{a}	0.51^{a}	25.10^{a}
15 min	0.04^{d}	0.11^{f}	4.48^{h}
Mean	***0.16***	***0.27***	***12.40***
UMUCASS 46			
5 min	0.04^{d}	0.10^{f}	7.64^{g}
10 min	0.27^{a}	0.38^{b}	8.28^{c}
15 min	0.05^{d}	0.16^{de}	4.63^{g}
Mean	***0.12***	***0.21***	***6.85***

Values represents average of duplicate results as values with different superscript are significantly different ($p<0.05$) along the same column. Mean represents average of triplicate results of three treatment time (5 min*, 10* min*, 15* min*) for different varieties.*

Abacha sample produced from UMUCASS 44 had the highest zinc content after 10 min of blanching, and the lowest content was after 5 min. While, *Abacha* samples produced from UMUCASS 45 had the highest zinc content after 15 min of blanching, and the lowest content was after 10 min. It was also observed that samples produced from UMUCASS 46 had the highest zinc content after 15 min of blanching, and the lowest content was after 5 min. The general outlook is that samples produced from UMUCASS 44 had the highest Zinc content of 1.33 mg/100g at 10 min blanching followed by UMUCASS 45 with a zinc content of 1.31 mg/100g at 15 min blanching and lastly UMUCASS 46 at 1.21 mg/100g at15 min blanching time. It was observed that top range values (Zinc content) were 1.21-1.33mg/100g, while blanching time were between 10-15 min. The implications of these results are significant, especially in regions where cassava is a staple food. Zinc is an essential micronutrient for human health, and cassava varieties with higher zinc content could contribute to addressing zinc deficiency in populations dependent on cassava. By understanding the factors that affect zinc content in cassava, breeding programs can be developed to enhance the zinc content in cassava varieties.

Iron is an essential mineral that plays a crucial role in various body functions, including the production of red blood cells and the transportation of oxygen. Adequate iron intake is important for maintaining good health, especially for individuals at risk of iron deficiency or Anaemia (Gupta, 2014). The Iron content of UMUCASS 44 ranged from 1.4 to 2.1 mg/100g. The iron content of UMUCASS 45 ranged from 1.4 to 2.1 mg/100g. The Iron content of UMUCASS 46 ranged from 1.4 mg/100g to1.7 mg/100g. *Abacha* samples produced from UMUCASS 44 had the highest iron content was observed after 15 min of blanching, and the least content was after 10 min of hot water blanching. *Abacha* samples produced from UMUCASS 45 had the highest iron content after 5 min of hot water blanching, and the least content was after 10 min. Samples processed from UMUCASS 46 had the highest iron content after 10 min of blanching, and the lowest content after 5 min of blanching.

Table 2: Effect of Blanching time on zinc, iron and potassium composition of *Abacha* from yellow flesh cassava varieties

Variety	Zn (mg/100)	Fe (mg/100g)	K (mg/ 100)
UMUCASS 44			
5 min	0.75^{g}	1.65^{c}	148.63^{b}
10 min	1.33^{a}	1.47^{d}	132.75^{d}
15 min	0.95^{e}	2.18^{a}	174.88^{a}
Mean	***1.01***	***1.76***	***152.42***
UMUCASS 45			
5 min	1.04^{d}	1.63^{c}	108.23^{e}
10 min	0.77^{g}	2.17^{a}	105.75^{f}
15 min	1.31^{b}	1.45^{d}	134.29^{c}
Mean	***1.04***	***1.75***	***116.08***
UMUCASS 46			
5 min	0.88^{f}	1.49^{d}	65.77^{i}
10 min	0.82^{fg}	1.485^{d}	86.78^{h}
15 min	1.21^{c}	1.715^{b}	103.66^{g}
Mean	***0.97***	***1.56***	***85.40***

Values represents average of duplicate results as values with different superscript are significantly different (p<0.05) along the same column. Mean represents average of triplicate results of three treatment time (5 min, *10* min, *15* min*) for different varieties.*

Potassium is an essential mineral that is needed by all tissues in the body. It is sometimes referred to as an electrolyte because it carries a small electrical charge that activates various cell and nerve functions (Weaver, (2013). They have been found to play important function which include promoting cardiovascular Health (D'elia *et al.*, 2011), blood pressure regulation muscle cramps and weakness prevention (Filippini *et al.*, 2017).

The potassium content of UMUCASS 44 ranged from 132.7 mg/100g to 174.8 mg/100g, while potassium content of UMUCASS 45 ranged from 105.7 mg/100g to 134.2 mg/100g. However, the potassium content of UMUCASS 46 ranged from 65.7 to 103.6 mg/100g. More so, *Abacha* samples processed from UMUCASS 44, had highest potassium content after 15 min of hot water blanching, lowest potassium content was after 10 min for the same sample. A study of the Table shows that for UMUCASS 45, the highest potassium content was observed after 5 min of blanching, and the lowest content was after 15 min. *Abacha* samples produced from UMUCASS 46 had the highest potassium content after 15 min of blanching, while the least potassium content was after 5 min. Based on the data from this research the blanching duration with the highest potassium content (mg/100g) among all *Abacha* samples produced from UMUCASS samples was 15 min, while UMUCASS 44 had the highest mean value of 152.42 mg/100g potassium.

Beta-Carotene and Cyanide Composition of blanched *Abacha* from Yellow Root Cassava Varieties

Table 3 shows the carotene and cyanide composition of blanched *Abacha* from yellow fleshed cassava varieties. The ß-carotene content of UMUCASS 44 *Abacha* samples ranged from 0. 80 to 2.08 µg/g, while that of UMUCASS 45 *Abacha* samples ranged from 0.84 to 1.84 µg/g. The ß-carotene content of UMUCASS 46 *Abacha* samples ranged from 2.43 to 5.81 µg/g. Whereas *Abacha* samples processed from UMUCASS 44, had highest ß-carotene content after 10 min of blanching, and the lowest ß-carotene content was after 15 min while samples from UMUCASS 45, had highest ß-carotene content after

5 min of hot water blanching, and the least ß-carotene content was after 10 min. *Abacha* samples from UMUCASS 46, had the highest ß-carotene content observed after 5 min of blanching, and the least content was after 15 min. The highest mean ß-carotene content was observed in *Abacha* samples from UMUCASS 46 (4.303 µg/g), followed by samples from UMUCASS 45 (1.21 µg/g) and samples from UMUCASS 44 (1.256 µg/g). *Abacha* samples processed from UMUCASS 44 had the highest ß-carotene content and the lowest cyanide content after a blanching duration for 10 min. Blanching for 5 min resulted in the highest ß-carotene content and the lowest cyanide content for *Abacha* samples processed from UMUCASS 45 cassava varieties; for *Abacha* products from UMUCASS 46, blanching for 5 min resulted in the highest ß-carotene content, while blanching for 10 min resulted in the ß-carotene content. Furthermore, *Abacha* samples processed from UMUCASS 44, had their ß-carotene content varies significantly depending on the blanching time with the highest ß-carotene content observed after 10 min of blanching (2.08 µg/g) which was significantly higher for the same sample after 5 min (0.89 µg/g) and 15 min (0.80 µg/g) of blanching. Beta-carotene is a type of pigment, specifically, a carotenoid (a pro vitamin A), that is responsible for giving certain fruits and vegetables their vibrant orange, red, or yellow colors. It is a precursor of vitamin A, meaning that the body can convert beta-carotene into active vitamin A as needed. Vitamin A is essential for maintaining good vision, a healthy immune system, and proper functioning of various organs (Vaibhav *et al.*, 2020). It is understood that ß-carotene is a pro-vitamin and acts as an important antioxidant and precursor of vitamin A in the body (Silva, 2021).

It is beneficial for eye health and immune function. Pro-vitamin A biofortified (yellow) cassava has the potential to contribute significantly to improve vitamin A status, especially in populations that are difficult to reach with other strategies (Talsma *et al.*, 2016).

Table 3: Effect of blanching time on ß-carotene and cyanide composition of *Abacha* from yellow flesh cassava varieties

Variety	ß-carotene (µg/g)	Cyanide (mg/kg)
UMUCASS 44		
5 min	0.89[fg]	3.92[c]
10 min	2.08[d]	2.29[g]
15 min	0.80[h]	3.53[d]
Mean	*1.26*	*3.25*
UMUCASS 45		
5 min	1.84[e]	2.80[f]
10 min	0.84[gh]	4.19[b]
15 min	0.95[f]	4.28[a]
Mean	*1.21*	*3.76*
UMUCASS 46		
5 min	5.81[a]	1.51[i]
10 min	4.67[b]	2.02[h]
15 min	2.43[c]	3.38[e]
Mean	*4.30*	*2.30*

Table 3 reports the effect of blanching time on the ß-carotene and cyanide composition of *Abacha* from Yellow fleshed Cassava Varieties. For samples produced from UMUCASS 45 the highest ß-carotene content is observed after 5 min of blanching (1.84 µg/g), which is significantly higher than the content after 15 min (0.95 µg/g). However, there is no significant difference in ß-carotene content between 5 and 10 min of blanching. Samples produced from UMUCASS 46 had the highest ß-carotene content is observed after 5 min of blanching (5.81 µg/g), which is significantly higher than the content after 15 min (2.43 µg/g). Additionally, the ß-carotene content after 10 min (4.67 µg/g) is significantly higher than that after 15 min. The significant differences in ß-carotene content suggest that blanching time has a notable impact on the retention of this important nutrient in *Abacha*. In some cases, such as UMUCASS 44 and UMUCASS 46, a specific blanching time (10 min for UMUCASS 44 and 5 min for UMUCASS 46) is associated with higher ß-carotene content. This information is essential for food processors and consumers who are interested in maximizing the nutritional value of the final product.

Cyanide is a toxic compound that can be found in cassava. Cassava contains cyanogenic glycosides, which are chemical compounds that can release hydrogen cyanide when broken down by enzymes in the body or gut microflora. If not properly detoxified, cyanide can result in fatal cyanide poisoning (Öztürk*et al.,* 2020). Cyanides are usually found in cassava, particularly in the peel and bitter varieties (Ndubuisi and Chidiebere, 2018). Blanching is one of the methods used to reduce cyanide levels in cassava-based foods (Cooke and Maduagwu, 2007). From Table 3.3 cyanide content ranged from 2.2 to 3.9 mg/kg while cyanide content for UMUCASS 45 and 46 ranged from 2.8 to 4.2 mg/kg, 1.5 to 3.3 mg/kg respectively. Is was observed that *Abacha* samples produced from UMUCASS 44 had the highest cyanide content observed after 5 min of blanching, and the lowest content was observed after 10 min of blanching. For UMUCASS 45 the highest cyanide content was observed after 15 min of blanching, and the lowest content was after 10 min. Samples produced from UMUCASS 46 had the highest cyanide content was observed after 15 min of blanching, and the lowest content was after 10 min.

The highest mean cyanide content was observed from samples produced from UMUCASS 44 (3.246 mg/kg), followed by samples from UMUCASS 45 (3.756 mg/kg) and UMUCASS 46 (2.303 mg/kg). It is worth noting that the levels of cyanide in the studied varieties are within acceptable limits of <10 mg/kg for safe consumption as reported by the World Health Organization (Smah *et al.,* 2020). Cyanide is naturally present in cassava, and proper processing techniques, such as blanching, are important to reduce its levels to safe limits. High cyanide levels can be harmful to health. In *Abacha* samples processed from UMUCASS 44, the cyanide content varies significantly depending on the blanching time. The highest cyanide content was observed after 5 min of blanching (3.92 mg/kg) which was significantly higher than the content after 10 min (2.29 mg/kg) and 15 min (3.53 mg/kg).
In *Abacha* samples processed from UMUCASS 45 highest cyanide content was observed after 15 min of blanching (4.28 mg/100g), which was significantly higher than the content after 5 min (2.80 mg/kg). There was also a significant difference between 10 min (4.19 mg/kg) and 15 min. For *Abacha* processed from UMUCASS 46 variety, the highest cyanide content was observed after 5 min of blanching (1.51 mg/kg), which was significantly higher than the content after 10 min (2.02 mg/kg). However, there was no significant difference between 5 and 15 min. The significant differences in cyanide content are crucial from a food safety perspective. Cyanide is a naturally occurring toxic compound in cassava, and excessive levels can be harmful to health. The results indicate that blanching time affects cyanide levels in *Abacha*, and longer blanching times tend to reduce cyanide content in some cassava varieties (UMUCASS 44 and UMUCASS 45).

Conclusion

The result of this study shows that hot water blanching at different times affect the quality outcomes and safety aspects of *Abacha.* These findings underscore the significance of blanching duration as a critical factor that influences the nutritional profile and safety of *Abacha*. The observed variations in vitamin and mineral content across different bio fortified cassava varieties emphasize the importance of tailored processing methods to maximize nutritional retention while ensuring safety standards. The study shows that UMUCASS 46 could be said to have the least cyanide content of 2.303 mg/g and highest ß-carotene of 4.303 mg/g. Understanding the nuanced effects of hot water blanching duration on specific nutrients facilitates informed decisions for food processors and highlights the potential to enhance the nutritional value of *Abacha*. Further research into optimizing processing techniques and exploring additional cassava varieties could offer valuable insights into refining these methods for better nutritional outcomes, addressing health concerns, and promoting the consumption of nutritionally rich traditional foods.

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