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Difference in Biochemical Compound and Cyanogen Content among Six Improved Cassava Root Adopted in Burkina Faso, Nutritional and Technological Perspectives

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Abstract Cassava is getting increase in food habit and production in Burkina Faso without appropriate knowledge of the nutritional and technological potential of the existing improved varities. Six Tropical Manihot Species cassava varieties were collected and transported within 24 hours for analyses using standard methods. The moisture content varies between 68.31±1.28 and 85.49±0.47%. The acidity is ranged between 0.49±0.04 and 0.85±0.13% and the pH varies between 6.05 and 6.62. Starch content of the cassava fresh root varies from 14.15±1.50 to 22.51±0.63%, amylopectin content varies between 10.36±2.17 and 20.72±5.56%; amylose content varies from 3.78±3.78 and 6.05±3.40%. Cyanogenic potential is range between 6.85±0.68 and 34.71±7.41 mg.kg^{-1}, the free cyanide content varies between 1.91±0.63 and 6.67±1.48 mg kg^{1}. Cassava fresh root is a source of potassium (202.4±4.64 mg 100g^{1}), calcium (25.30±0.75 mg 100g^{1}), magnesium (17.10±0.23 mg 100g^{1}), iron (11.81±15.02 mg 100g^{1}), phosphorus (4.8±0.27 mg 100g^{1}), zinc (2.55±3.70 mg 100g^{1}) and sodium (0.9±0.01 mg 100g^{1}). Some significant differences are observed for some compound and call for mixture use of varieties according to the final product.

Keywords: *cassava, improved varieties, biochemical, cyanogenic, difference*

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1. Introduction

Cassava (*Manihot esculenta* Crantz) is a food plant originated from the new world [1-4]. It's a woody plant with about 1 to 3 m as height belonging to *Manihot* gender and Euphorbiaceous family. It has been used as food in America's communities some centuries ago. Cassava is a staple food and animal feed in tropical and subtropical regions (Africa, Asia and Latin America) [2,5,6]. About 500 million people depend on it as a major carbohydrate source. Cassava is the third most important source of calories in the tropics after rice and maize. Cassava is growth in areas where food insecurity in general and hidden hunger in particularly is widespread and constitutes a challenge for politics [7]. Therefore, improving the nutritional value of cassava could alleviate food insecurity and some aspects of hidden hunger some part in the world [8,9].

In Burkina Faso, cassava has been introduced about a century ago from Ghana by both local traders and catholic white missionaries [10,11]. From the initials areas, cassava largely spreads and, it does now found in every region of the country. Cassava used to be an adequate solution to household food security during food shortage period in some regions and constitute a raw materials for several semi-artisanal units [11]. The fermentation technology incorporated in the cassava processing varies from African countries [11,12]. But the added value of cassava and adequate response to food insecurity throughout cassava requires industrial processing of cassava root. And this industrial processing call for adapted cassava varieties with low value of cyanide content and high level of nutritional value. The research on adequate cassava varieties performed by the National Institute of Environment and Agriculture Research (INERA) in partnership with International Institute for Tropical Agriculture (IITA) leads to new Tropical Manihot Species (TMS) cassava varieties with interesting

agronomic properties and more nutritional value. Several improved varieties are now available and adapted to the national agro-ecological conditions and the processing technology. Cassava is then more and more cultivated during both raining season and dry season under irrigation. The adoption of appropriate cassava variety, source of minerals and vitamins in family and industrial use with preservative process could be an alternative solution for food insecurity and hidden hunger in Burkina Faso. The aim of the present study is to evaluate the nutritional value and the cyanide content of the six improved Tropical Manihot Species genotypes grown in Burkina Faso.

2. Materials and Methods

2.1. Sampling

Cassava Tropical Manihot Spieces (TMS) improved genotypes where collected in the experimental site of INERA. The site is located in Bama town in the western part of Burkina Faso at about 400 km from Ouagadougou, the capital. Six Tropical Mahinot Species were: TMS 4 (2)1425, TMS 92/0067, TMS 92/0325, TMS 92/0427, TMS 91/02312 and TMS 94/0270. Then roots from five or six plants of each concerned cassava variety were harvested. The samples were collected in bags and transported within 16 hours in DTA laboratory for analyses. The cassava varieties have been described (Table 1) based on the literature, particularly the International Institute for Tropical Agriculture (IITA) and INERA and the cassava database [13,14].

2.2. Measurement of pH and an Acidity of Cassava Root

Ten gram (10 g) of each sample were dissolved in 50 ml of distilled water and then mixed. The pH was directly measured with a numeric pH-meter (WTW multi line P4). For total acidity, 10 g of each sample are mixed with 50 ml of distilled water in spinning cones. The cones were then centrifuged for 15 minutes (3900 rpm) and the supernatant was collected. The titration was made using KOH 0.1 N and phenolphthalein as indicator.

2.3. Proximate Composition of Cassava Root

Proximate analysis of samples was conducted using the following conventional procedures described by the Association of Official Analytical Chemists [15]. Dry matter was determinate by drying samples at 105±2°C overnight; ash content by incineration at 550°C for 12h, crude protein (N×6.25) by Kjeldahl method after acid digestion; and crude fat content by Soxhlet extraction using n-hexane as solvant. Total and reducing sugar content was determined by the phenol sulphuric and DNS acid method respectively according to [16]. The values were expressed in g/100 g of cassava fresh root. The starch, amylose and amylopectin content was determined using the colorimetric method described by [17]. The energy value was calculated using the method described by [18].

2.4. Mineral Analyses of Cassava Root

The contents of the minerals (Ca, Mg, Fe, Zn, Na, K, P) were determined after digesting of 0.5 g of sample using the Atomic Absorption Spectrophotometric method as outlined in the Association of Official Analytical Chemists Approved method [15].

2.5. Cyanide Content of Cassava Root

2.5.1. Sample Extraction

Each cassava variety fresh root was cut into fine particles and randomized. Then 70g of the randomized root particles were homogenized in 250 ml of refrigerated extraction medium made with 0.1 M orthophosphoric acid (CARLO ERBA, France) containing 25% v/v of ethanol (96%) in a blender. The homogenization was made in tree time : for 15 s at low speed, followed by 1 min high speed, 1 min rest and 1 min full speed again [19,20]. The homogenates were centrifuged in spinning cones at 10,000x g for 15 min and the supernatant was used as extract.

Table 1. Description of the selected cassava varieties

Parameters	TMS 4 (2)1425	TMS 92/0067	TMS 92/0325	TMS 92/0427	TMS 91/02312	TMS 94/0270
Origin	IITA	IITA	IITA	IITA	IITA	IITA
Pedigree	58308 Oyarugba funfun	(91934X TME) HS	(91934X TME) HS			
Estimated yield (T/ha)	30-40	30-40	30-40	30-40	30-40	30-40
Unexpected leaf color	Green purple	Green purple	Purple	-	-	-
1st fully expanded leaf color	Green purple	Green purple	Green purple	-	-	-
Pubescence of young leaf	Moderate	Moderate	High	-	-	-
Central leaf lobe shape	Elliptic	Lanceolate	Lanceolate	-	-	-
Petiole color	Light green	Red	Purple	-	-	-
Anthocyanin distribution of petiol	Top and bottom	Totally pigmented	Totally pigmented	-	-	-
Growth habit of stem	Zig-Zag	Straigtht	Straight	-	-	-
Stem color	Silver green	Dark green	Dark brown	-	-	-
Outer root skin color	Cream	Dark green	Dark brown	-	-	-
Inner root skin color	White or cream	Cream/white	Cream/white	-	-	-
Root flesh color	White	White	White	white	white	white
Root nect length	short	Short	intermediate	-	-	-
cycle plantation maturity (months)	06-12	06-12	06-12	06-12	06-12	06-12
Potential utilization in BF	Good for gari	Good for gari	Good for gari	Good for gari	Good for gari	Good for attiéké
Others caracteristics	Susceptible to viruses	Susceptible to viruses	Susceptible to viruses	Susceptible to viruses	Susceptible to viruses	Susceptible to viruses

2.5.2. Cyanogenic Potential Content of Cassava Root (CNp)

Cyanogenic potential content was quantified using 0.1 ml of each variety extract added to phosphate buffer (M/15 of KH_2PO4 and Na_2HPO4 in appropriate ratio). It followed an addition of 0.1 ml of linamarase (SIGMA Aldrich, UK) solution with 5 $EUml^{-1}$ as activity. After 15 min incubation at 30°C, 0.6 ml of NaOH (0.2 M) was added, followed after 5 min by 2.8 ml of phosphate buffer pH6. Then 0.1 ml Chloramine T (SIGMA Aldrich, UK) reagent (0.5g Chloramine T in 50ml distilled water) was added to the test tube and mixed. After 5 min, 0.6 ml of colour reagent was added and mixed. Colour reagent was prepare with 3.7 g NaOH in 200 ml distilled water followed by 7.0 g 1,3-dimethyl barbituric acid (SIGMA Aldrich, China) and 5.7g isonicotinic acid (SIGMA Aldrich, Germany). The absorbance at 605 nm was measured after 10 min. And, reagent blanks were run for each analysis. The standard curve was made using linamarin (SIGMA Aldrich, UK) according to [21,22,23].

2.5.3. Free cyanide Content of Cassava Root (HCN)

Free cyanide content was quantified using 0.1ml of the cassava root extract. Then 3.9 ml of phosphate buffer pH 4 was added to the extract. And 0.1 ml Choramine T (SIGMA Aldrich, UK) reagent was added to the test tube and mixed using a vortex. After 5 min, 0.6 ml of color reagent was introduced and mixed again. And the absorbance at 605 nm was measured after 10 min. A blank were realized for each sample. The standard curve was made with KCN [19,20].

2.5.4. Non-glycosidic Cyanogens Content of Cassava Root (ngCN)

Non-glycosidic cyanogens was calculated as the difference between the total cyanogenic potential and the free cyanide content.

2.6. Statistical Analysis

The dendogramme and Analyses of variance (ANOVA) were realized using XLSTAT-Pro 7.5. Means standard deviation and the least significant difference between the means were determined ($p<0.05$). Newman-Keuls correlations among nutritional and physicochemical values were estimated for all the investigated factors. Sofware R 3.1.2 was used for the principal composant analyze.

3. Results

3.1. Moisture Content and Acidity of Cassava Root

The moisture content of these improved TMS cassava varieties is range between 68.31±1.28 and 80.31±4.23 g/100g with an average of 73.72g/100g. The acidity varies between 0.49±0.04 and 0.85±0.13 g with an average of 0.67 and 0.54±00. The pH varies between 6.05 and 6.62 with an average of 6.36 as it describe in Table 2.

Table 2. Physicochemical properties of cassava root

Samples	Moisture	Dried Matter	pH	Acidity
TMS 4 (2) 1425	68.31±1.28^{c}	31.69±1.28^{c}	6.35±0.07^{a}	0.85±0.13^{b}
TMS 91/2312	73.09±1.71^{a}	26.91±1,71^{a}	6.45±1.71^{c}	0.54±00^{a}
TMS 92/0067	72.97±1.74^{a}	27.03±1.74^{a}	6.34±0.01^{a}	0.8±00^{b}
TMS 92/0325	78.98±0.07^{b}	21.02±0.07^{b}	6.62±0.05^{c}	0.58±0.22^{b}
TMS 92/0427	68.66±1.00^{c}	31.34±1.00^{c}	6.37±0.02^{a}	0.76±0.13^{b}
TMS 94/0270	80.31±4.23^{b}	19.69±4.23^{b}	6.05±0.02^{b}	0.49±0.04^{a}
Average value	73.72±1.67	26.28±1.67	6.36±0.31	0.67±0.08
Variation Rate	1.17	1.60	1.06	1.57

The same letters in a column are not significantly different at 5% level according to the test of Newman-Keuls.

3.2. Proximate Content of Cassava Root (g/100g)

Crude lipids vary from 1.7±0.21 (TMS 92/0427) to 2.58±0.42 g/100g (TMS 4(2)1425). The total sugar is range between 4.55±3.38 (TMS 4(2)1425) to 10.26±1.40 (TMS 92/0067) and the reducing sugar between 1.04±0.11 (TMS 4(2)1425) and 2.09±0.16 (TMS 92/0325). The ashes content is varying from 0.34±0.01 (TMS 92/0325 and TMS 92/0427) to 0.56±0.06 (TMS 94/0270). The protein content is range from 0.81 to 1.60±0.81 with an average of 1.04%. The energy value of cassava fresh root varies from 146.90 to 134.46 with an average of 133.06 Kcal/100g as indicated in Table 3.

3.3. Starch Content of Cassava Fresh Root

The starch content of cassava varieties fresh root varies from 14.15±1.50 (TMS 92/0325) to 22.51±0.63 (TMS 4(2)1425). Amylopectin content varies between 10.36±2.17 and 20.72±5.56 g/100g. The percentage of amylopectin from starch varies from 66.60±11.54 and 84.37±4.08. Amylose content varies from 3.78±3.78 to 6.05±3.40 g/100g and, the percentage from starch is range between 18.27±8.27 and 29.60±5.46 as showed in Table 4.

Table 3. Proximate content of cassava fresh root

Samples code	Ashes content	Crude Lipids	Total sugar content	Reducing sugar	Protein content	Energy Kcal/100g
TMS 4(2)1425	0.43±0.05^{a}	2.58±0.42^{c}	4.55±3.38^{a}	1.04±0.11^{a}	1.60±0.81^{a}	137.86
TMS 91/02312	0.47±0.08^{a}	1.89±0.23^{d}	7.40±0.79^{b}	1.42±0.21^{b}	0.84±0.06^{a}	129.93
TMS 92/0067	0.39±0.01^{a}	1.68±0.60^{a}	10.26±1.40^{b}	1.66±0.32^{c}	1.00±0.37^{a}	124.56
TMS 94/0270	0.56±0.06^{b}	2.38±0.04^{b}	7.11±1.22^{c}	1.46±0.27^{b}	0.81±0.00^{a}	134.46
TMS 92/0325	0.34±0.02^{c}	2.78±0.05^{c}	9.76±1.47^{b}	2.09±0.16^{d}	1.00±0.37^{a}	124.66
TMS 92/0427	0.34±0.01^{c}	1.7±0.21^{a}	6.65±0.47^{c}	1.23±0.12^{b}	1.00±0.00^{a}	146.90
Average value	0.42±0.04	2.16±0.26	7.62±1.45	1.48±0.20	1.04±0.27^{a}	133.06
Variation Rate	1.64	1.53	2.25	2	1.97	1.17

The same letters in a column are not significantly different at 5% level according to the test of Newman-Keuls.

Table 4. Starch content of cassava fresh varieties

Cassava clones	Starch (g/100g)	Amylose		Amylopectin	
		(%)	% of Starch	(%)	% of Starch
TMS 4(2)1425	22.51±0.63[a]	6.05±3.40[a]	27.00±5.87[a]	16.45±3.40[a]	70.33±3.55[a]
TMS 91/02312	19.99±1.71[b]	5.18±1.41[a]	26.01±8.30[a]	14.82±2.35[a]	66.60±11.54[a]
TMS 92/0067	16.10±0.63[c]	4.50±2.33[a]	28.08±5.60[a]	11.60±2.96[b]	76.87±6.74[a]
TMS 94/0270	20.34±1.64[b]	6.08±3.63[a]	29.60±5.46[a]	14.25±1.99[a]	67.80±1.04[a]
TMS 92/0325	14.15±1.50[a]	3.78±3.78[a]	26.12±2.30[a]	10.36±2.17[b]	84.37±4.08[b]
TMS 92/0427	25.25±3.05[d]	4.52±1.50[a]	18.27±8.27[a]	20.72±5.56[c]	83.69±7.37[c]
Average value	19.72±1.52	5.01±2.67	25.84±5.96	14.70±3.07	74.94±5.72
Variation Rate	1.78	1.60	1.62	2	1.27

The same letters in a column are not significantly different at 5% level according to the test of Newman-Keuls.

Table 5. Mineral content of cassava fresh root (mg 100g^{1})

Cassava Clones	Phosphorus (P)	Calcium (Ca)	Magnesium (Mg)	Potassium (K)	Sodium (Na)	Iron (Fe)	Zinc (Zn)
TMS 4(2)1425	6.30±0.54[a]	26.15±1.49[a]	17.83±0.17[a]	239.25±5.95[a]	0.8±0.02[a]	14.56±9.75[a]	2.67±3.2[a]
TMS 91/02312	2.95±0.03[a]	26.51±0.30[a]	14.22±0.06[a]	189.05±0.21[a]	0.9±00[a]	10.21±4.64[a]	3.32±0.99[b]
TMS 92/0067	6.85±0.49[a]	33.14±1.03[a]	16.10±0.48[a]	270.60±7.4[a]	1.1±0.02[a]	8.29±9.47[a]	1.80±10.3[c]
TMS 94/0270	2.55±0.15[a]	21.45±0.93[a]	17.60±0.02[a]	159.50±5.7[a]	0.8±0.02[a]	10.50±23.43[a]	2.62±2.8[a]
TMS 92/0325	7.30±0.28[a]	28.00±0.56[a]	18.30±0.42[a]	210.80±4.56[a]	0.8±0.03[a]	15.63±20.43[a]	2.11±3.7[a]
TMS 92/0427	3.35±0.15[a]	16.80±0.18[a]	18.50±0.22[a]	145.21±3.99[a]	1.0±0.03[a]	11.70±22.41[a]	2.77±1.2[a]
Average value	4.80±0.27	25.30±0.75	17.10±0.23	202.40±4.64	0.9±0.01	11.81±15.02	2.55±3.70
Variation Rate	2.92	1.81	1.27	1.86	1.37	1.88	1.84

Table 6. Cyanogenic content of cassava fresh root

Samples code	Cyanogenic potential CN_P (mg Kg^{1})	Non Glycosidic cyanogen		Free cyanide content	
		(mg Kg^{1})	% of Starch	(mg Kg^{1})	% of Starch
TMS 4(2)1425	15.76±2.92[a]	12.14±3.40[a]	77.02±2.08	3.62±1.14[a]	22.97±12.08
TMS 91/02312	10.56±0.78[a]	7.68±3.54[b]	72.74±16.45	2.88±0.23[a]	27.25±12.41
TMS 92/0067	22.76±9.65[a]	20.85±10.26[c]	91.60±3.64	1.91±0.63[a]	8.34±2.37
TMS 94/0270	8.34±3.14[c]	3.88±1.45[b]	69.92±16.60	1.67±0.55[a]	30.08±12.70
TMS 92/0325	6.85±0.68[c]	4.65±1.70[b]	67.88±5.80	2.20±1.87[a]	32.11±7.22
TMS 92/0427	34.71±7.41[d]	28.03±7.03[d]	80.75±1.4	6.67±1.48[b]	19.24±1.40
Average value	16.49±4.09	12.87±4.56	76.65±7.66	3.15±0.98	23.33±8.03
Variation Rate	5.06	7.22	1.34	3.99	3.85

The same letters in a column are not significantly different at 5% level according to the test of Newman-Keuls.

3.4. Minerals Content of Cassava Root (mg/100g of Dried Matter)

The minerals content of cassava varieties is as shown in Table 5. The main mineral of the cassava fresh root are respectively potassium (202.4±4.64), calcium (25.30±0.75), magnesium (17.10±0.23), iron (11.81±15.02), phosphorus (4.8±0.27), zinc (2.55±3.70) and sodium (0.9±0.01).

3.5. Cyanide Content (mg/kg of Fresh Root)

The cyanogenic potential is range between 6.85±0.68 (TMS 92/0325) and 34.71±7.41 (TMS 92/0427) and the free cyanide content varies between 1.67±0.63 (TMS 94/0270) and 6.67±1.48 (TMS 92/0427). The percentage of free cyanide content from the cyanogenic potential content varies from 19.24±1.40 to 30.08±12.70%. The non glycosidic cyanogen is range between 4.65±1.70 (TMS 92/0325) and 28.03±7.03 (TMS 92/0427). It percentage from the cyanogenic potential varies from 67.88±5.80 to 91.60±3.64%, Table 6.

4. Discussion

The physical and chemical properties are in accordance with results of [7,24] which showed respectively a dry matter content of 29.8-39.3 and 25-46 g/100g. But ours results are higher than the values of 9.2-12.3% obtained by [25]. The acidity of the varieties of this study are less than the better ones [26]. There is a significant different in the content of dry matter, pH and acidity according to the test of Newman-Keuls in a level of 5% (Table 2). And there is a correlation between the moisture content and the acidity. All the samples were all planted in a same experimental area. The difference is then tribute to the varietal effect. Previous work on the same varieties also showed a scale value of 25.39 to 45.89 g/100g for dry matter and a pH value of 5.70 to 6.25 [27]. The varietal difference was also found in others countries [24,28]. Previous studies also showed that cassava variety TMS 4 (2) 1425 from Ibadan has a dry matter range between 28.46 to 29.91 and the variety from Onne, a dry matter value of 34.76 to 35.54. The variety TMS 92/0067 respectively from Ibadan and Ubiaja has a dry matter

range from 23.10 to 25.75 and 36.88 to 40.75 [13]. Then, in addition to the varietal property, the difference in dry matter, pH and acidity may vary according to agroclimatics conditions.

The average of ashes content (0.42), crude lipid (2.17), total sugar (7.62) and soluble sugar (1.48) are similar to the results of [25,29,30]. The proximate compound varies between 1.53, 2.25 and 1.97 respectively for crudes lipids, total sugar and protein content. But the crude lipid content here found is more high and the ashes content is more low than those of [7,28,31]. The proximate compound of the cassava varieties fresh root varies significally from one variety to another according to Newman-Keuls test. This effect of varieties on proximate compound has been also put in evidence [25,32,33,34]. But the root age effect in proximate compound is not to be ignore [32].

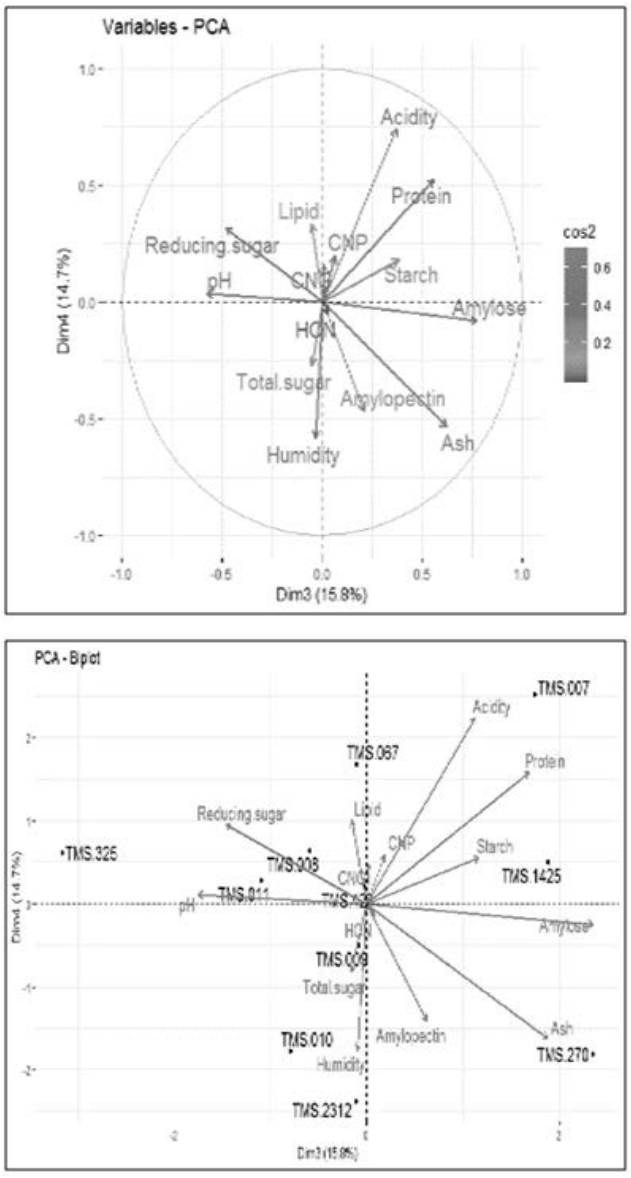


Figure 1. Principal compound analyse according to proximate compound

The average of starch content is 19.72 g/100g of cassava fresh root. TMS 92/0427, TMS 4(2)1425 and TMS 94/0270 have the highest content of starch and amylose. These value are in the same order of those of [22,28,32,35]. The variation rate is about 1.78 for total starch content, 1.60 for amylose and 2 times for amylopectin. This difference in starch, amylose and amylopectin content is significant according to the test of Newman-Keuls in a level of 5%. The effect of varieties in the content in starch amylose and amylopectin has been already put in evidence [22,32]. The PCA of the six cassava varities according to the proximate compound and cyanogen content is as showed in Figure 1.

The mineral content of cassava varieties here found varied a little in comparison with those found by [7,25]. There is not a significant difference in the content in each mineral of cassava root except the content in zinc according to Newman-Keuls test. Mineral content is suggested to correlate with soil compound and well as cultural technics [33,34,36]. Cassava is promoting to be use as raw material in infant porridge and others foods. The minerals content of the variety are not to be neglect. The minerals content need then to be combining with the other proximate compound. A mixture raw material (cassava variety) is tested. The PCA of mineral compound is shown in the following Figure 2.

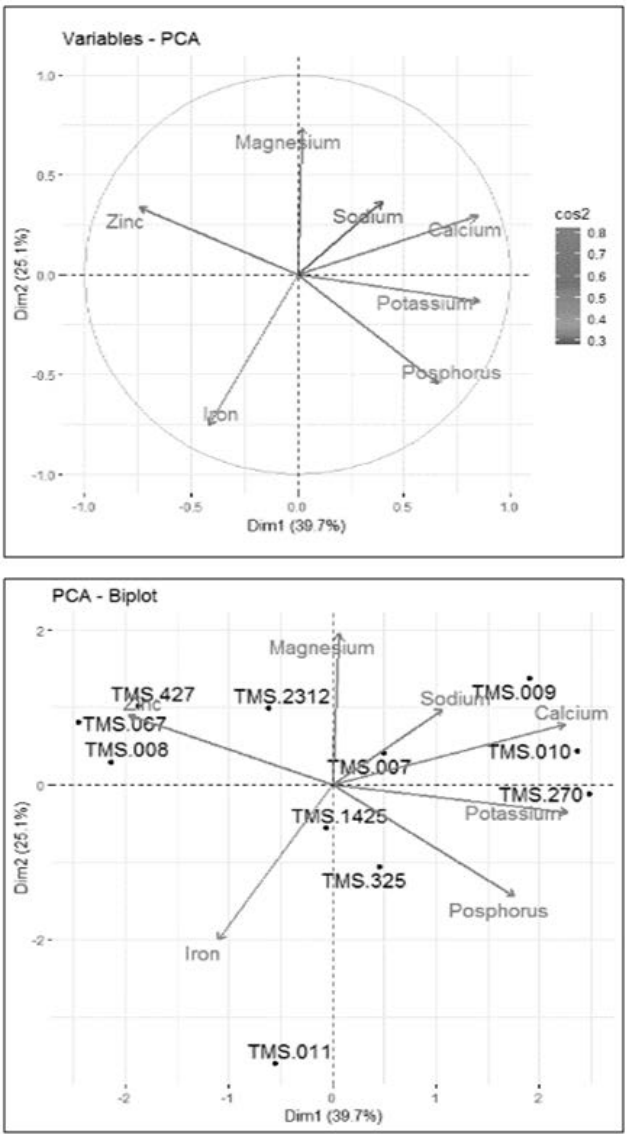
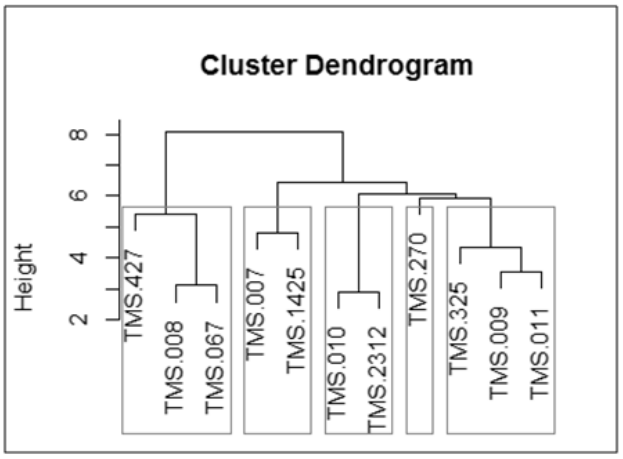


Figure 2. Principal compound analyse according to minerals content

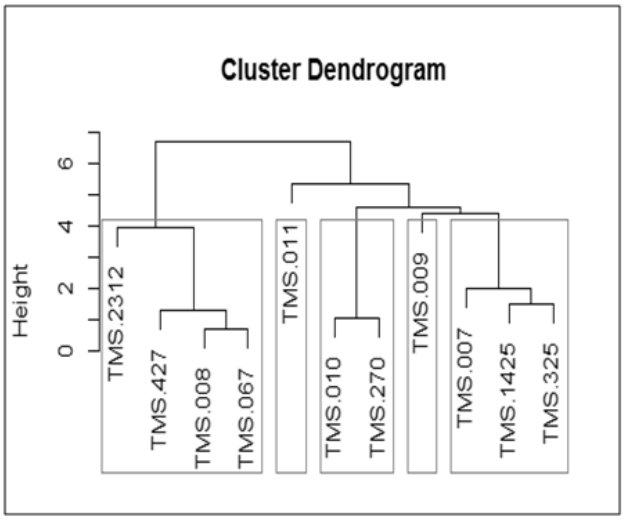
The varieties with a high level of cyanide content are respectively TMS 92/0427, TMS 92/0067, TMS4(2)1425. And, the low cyanide content varieties are TMS 92/0325

and TMS 94/0270 respectively. The TMS 94/0270 variety which has the low content in cyanogenic potential is also the more adapted in attiéké production according to [27,37,38]. The cyanogenic potential level found in this study is supported by literature on the same cassava varieties [13,22,39]. But some others results showed a higher value of cyanide content of fresh root [40,41,42]. The variation rate in the cyanogenic potential content among varieties is about 5.06 and 3.99 respectively for the free cyanide content and cyanogenic potential. There is a significant difference in cyanide content between varieties in a level of 5% according to the test of Newman-keuls. The variety impact on the cyanide content was already put in evidence [25,33]. But the soil compound have an impact on the cyanide content [13,32,34]. Some of the cassava nutritional value such as mineral, starch of cassava root also varies with the root age [32].

According to the similitude value of all analyses parameters, proximity of the six cassava variety can be illustrated as is shown in the following dendogramme (Figure 3). The similar varieties are respectively TMS 4 (2)1425, TMS 92/0067, TMS 92/0325, TMS 91/02312, TMS 94/0270 and TMS 92/0427.



a. Considering all proximate content



b. Considering minerals content only

Figure 3. Dendogramm of similarity of analysed cassava varieties

The principal compound analysed of the cassava varieties is showed in Figure 2. Variety TMS 4 (2)1425 has an important content in protein and magnesium. Variety TMS 92/0067content more calcium, total and reducing sugar. TMS 92/0325 variety has an high content of phosphorus, potassium and acidity when variety TMS 91/02312 has an high value of ashes and sodium. And TMS 92/0427 has the high value of starch and zinc.

Some biochemical contents of cassava varieties are correlated. Free cyanide is then correlate with amylopectin and reducing sugar content. The potassium content is in relationship with acidity, phosphorus and calcium. The content in phosphorus is correlate with acidity. And acidity is also correlate with moisture content. The stronger correlation is observed between starch and amylopectin. According to Figure 2, TM4(2)1425 content more magnesium and protein when TMS 92/0427 content more starch and amylopectin and zinc. TMS 91/02312 content more sodium and TMS 94/0270 content more ashes. Variety TMS 92/0067 content more calcium and reducing sugar when TMS 92/0325 content more potassium, phosphorus and acidity.

5. Conclusions

The six cassava TMS fresh root have appreciable proximate value content. The cyanogenic potential and the free cyanide content level proved that all the varieties are sweeter one. There is a diversity in the content of starch according to the proportion in amylose and amylopectin. Cassava improved varieties may be an alternative source of mineral. The variety effect on the proximate content as well as in starch, potential cyanogenic and mineral in evident. But the content in mineral of the soil and the root age has an impact on the biochemical compound of cassava fresh root. Their effect need to be appreciate for cassava biochemical compound optimization.

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