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Research Article

Physico-Chemical and Biochemical Characteristics of the *Assabonou* Mango Variety with a View to Valorization

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Abstract

In Côte d'Ivoire, mango (*Mangifera indica*) is one of the most widely consumed fruits after banana. However, the *assabonou* variety, an existing wild variety, is less consumed because of its fibrous character. With a view to promoting its consumption, the aim of this work is to characterize this mango from a nutritional point of view, with a view to its possible valorization. The physico-chemical and biochemical characteristics of this mango were analysed. For the analyses, 10 kg of *assabonou* mango were collected from each of the five villages in the Yamoussoukro district (Apkessekro, Assabonou, Logbakro, N'gokro and Sahabo). The physico-chemical analyses carried out showed that the pH of *assabonou* variety mangoes juices from these various towns ranged from 4.20 ± 0.17 to 4.53 ± 0.05. The titratable acidity varied from 0.56±0.01 to 0.063±0.01%. Titratable acidity ranged from 0.56±0.01 to 0.063±0.01%. Soluble sugar content ranged from 12.16±0.28 °Brix to 14.83±0.57 °Brix. Dry matter content ranged from 13.75±2.20% to 20.38±1.81%. Biochemical analysis showed that *assabonou* mango variety samples were essentially rich in Potassium, Magnesium and Calcium, with averages of 55.56 mg/100g MS, 12.61 mg/100g MS and 19.30 mg/100g MS respectivelyMacronutrients included digestible carbohydrates (15.192 g/100 g DM), fiber (2.44 g/100 g DM), protein (0.73 g/100 g DM), total sugars (13.69 g/100 g DM) and reducing sugars (1.72 g/100 g DM). In view of its nutritional potential, steps should be taken to limit losses due to rotting during harvesting periods, by planning its transformation into fermented products for the production of beverages or novel foods.

Keywords

Mango, *Assabonou*, Nutritional Properties, Valorization

1. Introduction

In Côte d'Ivoire, several improved mango varieties such as *Amélie*, *Kent* and *Brooks* are grown and exported, as they are appreciated by the local population. With an average production of 100,000 tonnes of mango per year, Côte d'Ivoire is the sixth largest producer in the West African Economic Community [1]. Mango exports generate more than 7 billion CFA francs in revenue (local sales and exports) and provide producers with around 1 billion CFA francs in annual income [2]. In other hand, the Ivorian fruit sector, which includes the banana, pineapple and mango trio, represents 3% of agricultural GDP and is the second largest export product in volume terms after the coffee-cocoa binomial [1, 3]. However, there are also large quantities of wild, non-imported varieties, which are

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difficult to consume because they are described as fibrous mangoesThis is the case, among others, of the "*assabonou*" variety found in certain regions of Côte d'Ivoire, whose fruit is highly perishable [4]. A large quantity of this fruit left in the fields to rot or to be collected and later disposed of as waste. These practices not only create both an ecological and economic problem, but also affect the market value of the fruit, causing losses of up to 90% [5]. Yet fruit is generally the main source of micronutrients for a balanced diet. They play a complementary nutritional providing the body with vitamins, mineral salts, dietary fiber and organic acids [6], all of which are essential for proper functioning. Regular, sufficient and varied fruit consumption is essential for a balanced diet and the maintenance of good health [7]. According to the WHO, around 2.7 million lives could be saved per year if fruit were sufficiently consumed [8]. Several epidemiological studies have shown a close link between fruit or fruit juice consumption and the prevention and management of metabolic diseases and malnutrition due to micronutrient deficiencies (vitamin A, iron, zinc and iodine), the prevalence of which remains high in sub-Saharan Africa 10]. Taken as an example, iron deficiency affects 67% of children under 5 in sub-Saharan Africa [11]. Several studies have shown the presence of local food products in Africa that could effectively contribute to nutrition, food security, health and income in rural communities. their importance and contribution to food security and poverty reduction tend to be underestimated. As a result, they are not optimally exploited. For several years, the FAO has strongly recommended their valorization, popularization and systematic integration into relevant programs and policies [12], as these fruits are nutritious and rich in phenolic compounds and antioxidants. This is the context of our study, which aims to characterize the *assabonou* mango variety from a nutritional point of view, with a view to its possible valorization.

2. Material and Methods

2.1. Biological Material and Sampling Area

The biological material for this study consisted of samples of mangoes (mangifera indica) of the *'assabonou'* variety from five villages in the Yamoussoukro (Côte d'Ivoire) district: three in the town of Yamoussoukro (Sahabo, Apkessekro, Logbakro, Assabonou and N'gokro). (Figure 1)

Figure 1. *Assabonou mango variety.*

2.2. Methods

2.2.1. Sampling

Assabonou mango variety samples were collected from fields in 5 villages. The villages were Apkessekro, Assabonou, Logbakro, N'gokro and Sahabo) in the town of Yamoussoukro (political capital of Côte d'Ivoire). Mature fruit was collected randomly from wild mango trees of the *assabonou* variety. In each case, a mass of 5 to 10 kg was picked and packed in perforated cardboard boxes, then sent to the Microbiology and Food Biotechnology laboratory at NANGUI ABROGOUA University for analysis.

2.2.2. Extraction of Mango Juice

The mangoes were first sorted according to their degree of maturity. Sorting is a necessary operation for two reasons: either the mangoes are too ripe and therefore some would be rotting, or the batch could contain immature fruits, which would affect the extraction yield. Then, they were washed and soaked in boiling water for 30 min at 100 ℃. This operation not only prevents the finished product from browning, but also partially destroys the vegetative forms of microorganisms that can alter the product over time. Finally, the fruits were peeled and the pulp was extracted by removing the pits. The pulp was crushed in a blender and filtered through muslin. The filtrate obtained was weighed. For five (5) kg of mangoes, three liters of mango juice were obtained.

2.2.3. Analysis of Physico-Chemical Parameters

Hydrogen potential (pH) and titratable acidity were determined using the method of [13]. pH was measured potentiometrically using the electrode of a pH meter (Wtw pH 302). Ten milliliters (10 ml) of mango juice were taken and the pH was measured using a pH meter (Hanna instruments hi98150), the value of which was read directly on the pH meter display. Titratable acidity was obtained by dosing 10 ml of each mango juice sample with a 0.1N sodium hydroxide solution, after first adding 2 to 3 drops of 1% phenolphthalein. The end of the assay is marked by a persistent pale pink coloration. Refractometric Dry Extract was determined using the method [14]. A drop of mmango

juice was placed on the glass of a pocket refractometer (Model Atago pocket refractometer) to assess the amount of suspended solids. The Refractometric Dry Extract value was read in the light, through the refractometer's eyepiece. The method used to determine water content is that proposed by [15], based on the loss of sample mass in an oven at 105 ℃ until a constant mass is obtained.

2.2.4. Biochemical Analysis

(i). Macronutrient Content

The method used for ash determination is that described by [15], which involves incinerating a sample at 550 ± 15 ℃ for 12 to 24 hours until white ash is obtained. Fiber content was determined using the method of [16]. A quantity of 2 g of mango juice weighed in a boccal was introduced into a flask and homogenized with 50 mL of 0.25 N sulfuric acid. This was brought to the boil using a heating cap (JP Selecta, Spain) for 30 min. Next, 50 mL of 0.31 N sodium hydroxide was added to the contents, and the whole was brought to the boil for 30 min. The extract obtained was filtered through Whatman No. 00 filter paper and the residue was washed several times with hot water until the alkalis were completely removed. After washing, the residue was oven-dried (Memmert, Germany) at 105 ℃ for 8 h, cooled in a desiccator and weighed. The dry residue obtained was incinerated in a muffle furnace (Pyrolabo, France) at 550 ℃ for 3 h, cooled in a desiccator and weighed again. Total sugar content was determined using the phenol-sulfuric method described by [17]. Quantification of reducing sugars was carried out using the method of [18]. A calibration range using a 0.1 mg/mL glucose standard solution was used to determine total and reducing sugars. Lipid content was determined as described by [19], using the Soxhlet as extractor. This is done by the liquid-liquid extraction method. Three consecutive extractions were performed. For the first extraction, to twenty (20 mL) of *assabonou* mango juice were added 20 mL of hexane, the mixture was then vigorously shaken and left to settle. A volume of 10 mL of hexane was added to 20 mL of the decantate from the first extraction, for the second extraction. The same operation was repeated for the third extraction. After lipid extraction, the hexane was evaporated on a rotary evaporator. The tared extraction flask was dried in an oven at 103 ℃ for 20 min. At the end of this operation, the lipid flask was weighed to determine the total lipid content as a percentage. Total protein was determined by assaying total nitrogen using the Kjeldhal method [15]. It comprises a mineralization phase, followed by a distillation phase and a sulfuric acid titration phase. Mineralization was carried out for 2 hours in a Kjeldahl matron at 400 ℃, followed by distillation for 10 min. The resulting distillate was titrated with sulfuric acid solution (0.1N) until the color changed from green to pink (V1). A blank test (V0) was carried out and the total protein content determined. Total carbohydrates (Glu) and energy value (VE) were determined using the [9] method. These methods take into account the moisture, fat, protein, ash and fiber contents, as well as the energy coefficients relative to the samples.

(ii). Antioxidant Potential

For the determination of total phenols, 0.5 ml of *assabonou* mango juice with a concentration of 0.1g/ml is added to 5 ml of folin-ciocalteu diluted 1: 10 in distilled water and 4 ml of sodium carbonate (1M). The mixture is incubated at room temperature for 15 minutes. Optical densities are then read in a spectrophotometer at 765nm against a blank containing everything but the extract [20]. Total flavonoids in *assabonou* mango juice were determined using the colorimetric method described by [21] using aluminum trichloride (AlCl3). A 0.5 mL aliquot was mixed with the same volumes of distilled water, aluminum trichloride ($AlCl_3$) 10% (w/v) (Labosi, Paris, France), sodium acetate (1M) and 2 mL distilled water. After 30 min incubation at room temperature, absorbance at 415 nm was assessed (UV Analytic spectrophotometer; USA). Condensed tannins in the various Assabonou mango juice samples were determined using the method described by [22]. To 400 µL of each sample or standard, 3ml of 4% methanolic vanillin solution and 1.5 ml of concentrated hydrochloric acid are added. The mixture is incubated for 15 min and the absorbance is read at 500nm. Vitamin C content can be measured by titrating the juice with sodium 2, 6-dichlorophenolindophenol (DCPIP). 50 mL juice was taken and placed in a 100 mL flask, made up to 100 mL with 1% oxalic acid and homogenized. 10 mL diluted fruit juice was taken and 2.5 mL acetone added. The mixture was then placed in the dark for 10 min. The solution was titrated with 2, 6-dichlorophenolindophenol (DCPIP) 0.05% until the solution turned red. Carotenoids were determined using the method of [23]. A 10 g *assabonou* mango pulp was ground in 40 ml 96% ethanol. The crushed material was poured into a separating funnel and 100 ml of hexane added. The supernatant is collected and evaporated for 24h. OD is read at 450 nm against beta-carotene stock solution (0.1 µg/ml). The volume to be determined is 4 ml. The method used for DPPH determination is that of [24], with slight modifications. Sterile, dry tubes are filled with 1 mL of mango juice to be analyzed and 2 mL of DPPH solution. After shaking, the tubes are placed in a dark place for 30 min. The absorbance of the mixture is measured at 517 nm against a blank consisting of (2 mL DPPH solution + 1 mL absolute EtOH).

(iii). Mineral Elements

Mineral determination was carried out according to the method of [25]. After cooling in a desiccator, the ash was dissolved in 5 mL chloridric acid (20%) and 1 mL concentrated nitric acid. The mixture was placed in a water bath for one hour, and brought up to the mark with distilled water in a 50 mL flask. The elements in the solution were then determined by Atomic Absorption Spectrophotometer (AAS). To avoid interference from the elements Ca and K, lantane

chloride was added (5 mL lantane). Minerals were determined using an air-acetylene flame atomic absorption spectrophotometer (SAA 20 type VARIAN). The wavelengths of the minerals K, Zn, Fe, Mg, Mn, Ca and P are 767.6 nm; 214.6 nm; 249 nm; 286 nm; 280.6 nm; 422.71 nm and 885 nm respectively.

2.2.5. Statistical Analysis

The assays were performed in triplicate and the data presented are the means and standard deviations of these three determinations calculated with Excel 2016. Means obtained after different treatments were compared by analysis of variance (ANOVA) using Duncan's multiple comparison test at 5% level of significance.

3. Results and Discussion

In Côte d'Ivoire, the mango (*Mangifera indica*) is one of the most widely consumed fruits after the banana. However, the *assabonou* mango variety, a wild variety found in very large quantities in certain regions of Côte d'Ivoire, is difficult to consume because it is described as fibrous. This mango is left in the fields to rot or to be collected and disposed of as waste. The physico-chemical and biochemical properties of the "*assabonou*" mango variety were characterized with a view to its use in food technology. Analysis of the results of the physico-chemical and biochemical properties revealed that *assabonou* mangoes have an acidic character that varies from one village to another. The pH of mangoes juices varied from 4.20±0.17 from the Assabonou village to 4.53±0.05 from the Akpessekro village. While the high titratable acidity was identical (0.063±0.005%) in mango juices from Apkessekro, Assabonou and Logbakro, it was similar to the acidity (0.056±0.01%) recorded in mango juices from N'gokro and Sahabo villages. Acidities rate obtained in juices are not significantly different ($P > 0.05$) (Table 1).

Table 1. *Physicochemical characteristics of assabonou mangoes variety collected in the villages.*

Parameters					
Villages	**pH**	**Titratable Acidity (%)**	**R.D.E (°Brix)**	**Humidity (%)**	**Dry matter (%)**
Apkessekro	4.53 ± 0.05^{b}	0.063 ± 0.005^{a}	12.16 ± 0.28^{c}	84.10 ± 0.10^{ab}	15.92 ± 0.091^{ab}
Assabonou	4.20 ± 0.17^{a}	0.063 ± 0.005^{a}	13.83 ± 0.28^{ab}	86.37 ± 2.18^{a}	13.746 ± 2.201^{a}
Logbakro	4.23 ± 0.05^{a}	0.063 ± 0.005^{a}	13.16 ± 0.28^{a}	82.003 ± 0.11^{b}	17.990 ± 0.115^{b}
N'gokro	4.43 ± 0.05^{b}	0.056 ± 0.01^{a}	14.33 ± 0.57^{b}	85.18 ± 0.13^{a}	14.83 ± 0.138^{a}
Sahabo	4.36 ± 0.05^{ab}	0.056 ± 0.01^{a}	13.83 ± 0.28^{ab}	79.61 ± 1.81^{c}	20.380 ± 1.81^{c}

Values with different alphabetic letters in the same column are significantly different ($p < 0.05$)
RDE: Refractometric Dry Extract

These levels of acidity are in accordance with the European standard, which should not be less than 5% [26]. This similarity in acidity could be explained not only by the degree of ripening of the mangoes picked in the villages but also by the presence of organic acids in the *assabonou* mangoes variety. Indeed, the titratable acidity observed in the juices is probably due to the accumulation of organic acids, mainly acetic acid produced by acetic bacteria but also by yeasts that produce small amounts of acetic acid as by-products [27]. Thus, the pulp of the *assabonou* variety mango could give juice with an acidity favorable to its stabilization against its degradation by microorganisms [28]. The *assabonou* mango variety has a high water content that varies from one village to another (between 82±0.11% and 86.37±2.18%). This high water content is the basis of the perishable nature of the *assabonou* mango variety. According to [29], a high water content is the origin of the perishable nature of the mango. However, this content is lower than that of the ripe springfield mango variety which has a water content of 96.1%. [30]. It could be said that the mango would be better preserved compared to the springfield mango because the water content influences the preservation of food [29]. Concerning the values of the refractometric dry extract, the content varies according to the origin of the mango. The content varies from 12.0 to 14.33 degrees Brix in the five villages (Table 1). However, in Table 2, the total sugar content is lower in mangoes juice from Assabonou village (10.68±0.34%) and mangoes juice from Sahabo village had the highest rate (15.76±0.14%). The highest reducing sugar content was recorded in mangoes juice from Logbakro village (1.96±0.11%) and the lowest with mangoes collected in N'gokro village (1.44±0.024%).

Table 2. *Macronutrient contents of the assabonou mango variety.*

villages					
Parameters	**Apkessekro**	**Assabonou**	**Logbakro**	**N'gokro**	**Sahabo**
Ashes (%)	0.48 ±0.005^{a}	0.64 ±0.01	0.45 ±0.01^{c}	0.50 ±0.01^{a}	0.65 ±001^{b}
Fibers (%)	2.13 ±0.030^{c}	2.59 ±0.11^{b}	2.62 ±0.034^{b}	2.38 ±0.05^{a}	2.48 ±0.028^{a}
Reducing sugars (%)	1.60 ±0.09^{a}	1.94 ±0.21^{b}	1.96 ±0.11^{b}	1.44 ±0.024^{a}	1.66 ±0.28^{ab}
Total sugars (%)	14.40 ±0.40^{b}	10.68 ±0.34^{c}	13.93 ±0.17^{ab}	13.68 ±1.12^{a}	15.76 ±0.14^{d}
Total carbohydrates (%)	14.56 ±0.09^{ab}	12.20 ±2.39^{a}	16.69 ±0.15^{bc}	13.45 ±0.26^{a}	19.06 ±1.83^{c}
Lipids (%)	0.086 ±0.005^{a}	0.093 ±0.005^{a}	0.093 ±0.015^{a}	0.056 ±0.040^{a}	0.083 ±0.015^{a}
Protein (%)	0.80 ±0.00^{a}	0.75 ±0.05^{a}	0.74 ±0.05^{a}	0.80 ±0.1^{a}	0.58 ±0.02^{b}
Energy value (Kcal /100g)	62.20 ±0.31^{bc}	51.85 ±8.22^{a}	70.61 ±0.47^{cd}	57.52 ±0.31^{ab}	79.35 ±7.14^{d}

Values with different alphabetic letters in the same row are significantly different ($p < 0.05$)

These differences in sugars in different mango juices would be due to the very large variation in the composition of the pulp depending on the geographical area, soil quality, harvest season and state of maturity of the fruit as noted by several authors [31]. These values of soluble sugars of the mango variety "*assabonou*" are lower than those found by [32] who worked on the black plum, the Kent mango from northern Côte d'Ivoire. However, the lowest rate of total carbohydrates was recorded in the juice of mangoes from the village of Assabonou (12.20 ±2.39%) and the highest rate in the juice of mangoes from the village of Sahabo (19.06 ±1.83%). These sugars are included in the range of the pulps they analyzed (2.70-6.41 g Eq Glucose/100 g DM). Because of this high content of total carbohydrates, these fruits can be considered as energy foods [33]. The percentage of fiber is between 2.13 ±0.030% (mango from Apkessekro) and 2.62 ±0.034% (mango from Logbakro). The presence of fiber in these mangoes would be an advantage for the consumer. Indeed, dietary fiber lowers blood pressure, waist circumference, blood sugar and plasma concentration of C-reactive protein. They increase satiety and insulin sensitivity, thus contributing to the prevention and management of obesity and its complications [34]. An increase in the consumption of one gram of total fiber reduces body weight by 0.25 kg and fat by 0.25% [35]. Fiber also contributes to improving intestinal transit but also has a preventive action on cardiovascular diseases and certain cancers [33]. The *assabonou* mango variety contains dietary fiber, it could be a functional food for health.. The considerable presence of crude fibers in the pulp would help improve the lipid profile of those who consume this mango [34] because the total lipid content obtained in this mango is lower than that included in the range mentioned in the literature (0.2-15.5%) [36, 37]. In this study, the quantities of lipids vary from 0.056±0.04% (mango of N'gokro origin) to 0.093 ±0.005% (mango of Assabonou origin). The protein content of mangoes of the Assabonou variety in the five villages varies from 0.58 ±0.02 to 0.80 ±0.1%. The mangoes collected in the villages of Apkessekro and N'gokro recorded the highest values. The protein contents of the *assabonou* variety mango obtained are similar to that of the Amelie variety obtained by [38], in Burkina. Although the proportion of essential amino acids is in quantities lower than those recommended by FAO/WHO/UNU, proteins help in growth and cell regeneration. Thus, the consumption of *assabonou* mango variety or derived products would contribute to meeting the needs in essential amino acids. Amino acids contribute to the nutritional value of foods. They can also participate in the production of aroma compounds in foods such as cheese, wine, honey and other fermented foods [39]. The low protein contents would be linked to the biosynthesis of polyphenols. Indeed, amino acids and more specifically phenylalanine serve as precursors for the biosynthesis of certain polyphenols [40]. The highest energy value was obtained in mangoes juice from Sahabo (79.35 ±7.14%) and the lowest in mangoes juice from Assabonou (51.85 ±8.22%). These results are similar to those of [41], who respectively reported energy values of 50-60 Kcal/100g, 62 Kcal/100 g and 58 Kcal/100 g for mango varieties from India and Bangladesh. These results show that the *assabonou* mango variety is essentially a carbohydrate fruit which, like most fleshy fruits, represents a significant source of energy for the human diet. In this respect, it is comparable to papaya (Carica papaya L.) and guava (Psidium guajava L.), whose respective energy values are 44 Kcal /100 g and 52 Kcal /100g [42]. Also, this energy would be of great interest to the animal organism as it would cover maintenance and production needs [43]. Furthermore, ash analysis of the samples revealed that *assabonou* mango pulps are essentially rich in potassium (K), calcium (Ca) and magnesium (Mg). Recorded potassium values ranged from 50.68 ±0.413 mg/100g for juice extracted

from mangoes from the village of Assabonou, to 60.35 ±0.604 mg/100g for mangoes juice from N'gokro (Figure 2).

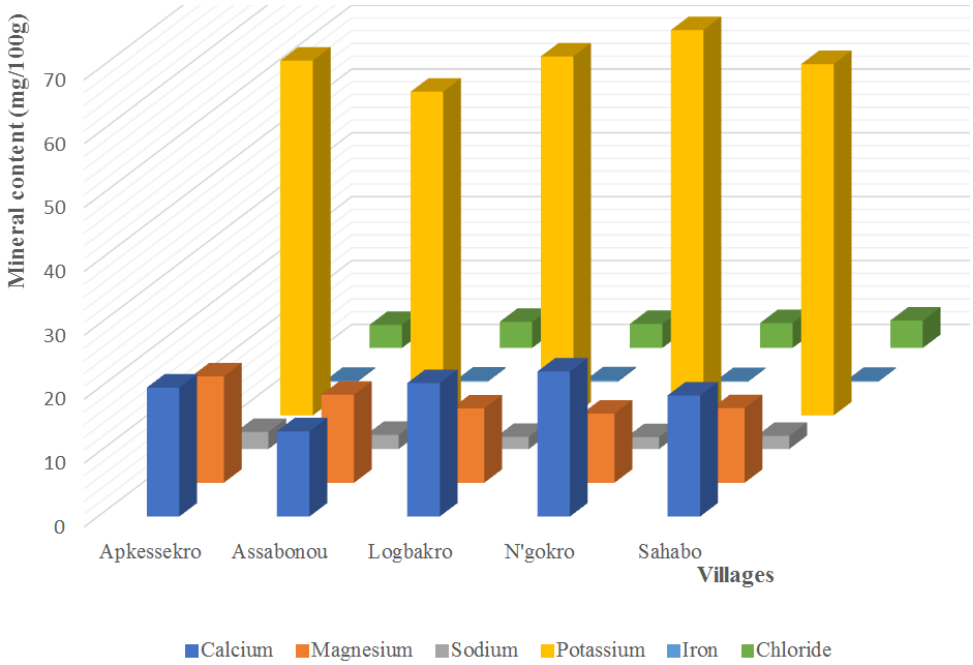

Figure 2. *Mineral composition of the assabonou mango variety.*

Potassium is the most abundant mineral in *assabonou* mangoes variety. However, the potassium content of *assabonou* mango variety is lower than that of the Amélie variety from Burkina Faso, whose average is 950±176 mg/100g, as reported by [38]. However, this Potassium content of the *assabonou* mango variety is higher than that of the black plum from northern Ivory Coast reported by [32] which is between 36.67 ± 8.88 mg/100g and 53.68 ± 6.18 mg/100g. The *Assabonou* mango variety is therefore a significant source of potassium. The consumption of this fruit could help meet the daily nutritional requirement for potassium and avoid dysfunctions in the human body. Potassium is also used to maintain the balance of electrolytes in the body, lower blood pressure in Na-sensitive patients and maintain muscle activity in general [44]. It should also be noted that potassium and sodium are very important in the regulation of muscle contraction and the transmission of nerve impulses. A high K/Na ratio would play a role in the excretion of excess water and salt [45]. In this study, the sodium content is lower than that of potassium suggesting a high K/Na ratio. The calcium content ranged from 13.78±0.351 (mangoes juice from Assabonou) to 22.70±0.610 mg/100 g (mangoes juice from N'gokro) and Sudan (344 mg/100 g) [46]. Calcium is one of the major minerals in the human diet. It is one of the major constituents in bone formation; its ions play an important role in several metabolic processes (muscle contraction). High consumption is especially recommended for pregnant women and children [47]. *Assabonou* mango variety fruit pulp would therefore be an important natural source of calcium. [33]. It should also be noted that magnesium is one of the major minerals in the human diet as a cofactor of several enzymes and an essential constituent in bone formation and function. The results of this work show that the *assabonou* mango variety has potential for the management of certain conditions such as chronic muscle weakness, cramps, fatigue, memory loss and cardiac arrhythmia [48]. The highest amount of magnesium was recorded in the juice from mangoes collected in the village of Apkessekro (16.66±0.329 mg/100 g), and the lowest amount was obtained from mangoes from N'gokro (10.83±0.386 mg/100 g). In other hand, low quantities of sodium (Na) and chloride (Cl) were detected in *assabonou* mangoes variety, whatever their origin (Figure 2). However, the small quantities of chloride recorded in the samples are an important factor in balancing the quantities of water inside and outside the cells. In fact, chloride is involved in regulating blood pH (acidity level). In the stomach, it is used to produce hydrochloric acid, a constituent of gastric juice, which is involved in food digestion [49]. However, iron deficiency in *assabonou* mangoes variety is observed in all samples. This deficiency could cells His deficiency leads to anemia, which is a major health problem affecting around two million people worldwide [50]. As reducing organic acids (vitamin C) promote the absorption of iron, the richness of *assabonou* mangoes variety in vitamin C would be an asset in potentiating the absorption of this iron. The vitamin C content of *assabonou* mango ranged from 17.66±0.42 to 20.83±1.44 mg /100g across the five sampling sites (Table 3).

Table 3. Antioxidant potential of the assabonou mango variety.

Villages					
Parameters	**Apkessekro**	**Assabonou**	**Logbakro**	**N'gokro**	**Sahabo**
Total phenol (mg/ml)	0.021 ± 0.001^{a}	0.023 ± 0.004^{ab}	0.029 ± 0.001^{b}	0.025 ± 0.006^{ab}	0.027 ± 0.002^{ab}
Flavonoids (mg/ml)	0.058 ± 0.005^{c}	0.051 ± 0.017^{bc}	0.031 ± 0.007^{a}	0.031 ± 0.007^{a}	0.034 ± 0.005^{ab}
Tannins (mg/100g)	17.78 ± 0.58^{a}	37.90 ± 0.24^{d}	36.07 ± 0.28^{c}	23.82 ± 0.57^{b}	39.07 ± 0.18^{e}
Vitamin C (mg/100g)	19.58 ± 0.71^{a}	17.66 ± 0.42^{b}	20.43 ± 0.75^{a}	19.58 ± 0.72^{a}	20.83 ± 1.44^{a}
Carotenoids (mg/100g)	0.42 ± 0.01^{d}	0.54 ± 0.01^{ab}	0.52 ± 0.01^{a}	0.56 ± 0.01^{b}	0.34 ± 0.005^{c}
DPPH	53.36 ± 0.5^{ab}	58.37 ± 1.34^{a}	56.61 ± 2.50^{a}	69.98 ± 6.02^{c}	48.80 ± 4.5^{b}

Values with different alphabetic letters on the same line are significantly different ($p < 0.05$), DPPH: 2, 2-DiPhenyl-1-PicrylHydrazyl

These results are superior to those of [30], whose work sprind field mango, revealed levels ranging from 14.34 ± 0.02 mg /100g to 15.05 ± 0.07 mg /100 g. *Assabonou* mango variety has a higher vitamin C content, which is essential for the body to function properly. In fact, vitamin C plays a role in mechanisms as diverse as they are important to human health: immune reactions, cellular oxidation, cancer, hypertension, cardiovascular risks and cataracts [51]. Apart from vitamin C, other antioxidants have been found in *assabonou* mangoes variety. These were total phenols, flavonoids, tannins, carotenoids and DPPH. In fact, antioxidants play a crucial role in improving the growing problem of prevention and management of chronic diseases (cancer, diabetes, cardiovascular disease...). Phenolic compounds are one of the main antioxidant molecules found in the diet that reduce oxidative stress [52].

4. Conclusion

In short, due to its richness in nutrients and phenolic compounds and its antioxidant potential, the optimized *assabonou* mango variety will contribute to maintaining health and fighting metabolic diseases linked to oxidative stress. Furthermore, its high water content is the main limiting factor for its conservation in the fresh state. Thus, given its nutritional potential, measures should be taken to limit losses due to rot during harvest periods by planning its transformation into fermented products from bacteria isolated on the surface of mangoes.

Abbreviations

GDP	Gross Domestic Product
DPPH	2,2-diphenyl 1-picrylhydrazyl
WHO	World Health Organization
UNU	United Nations University
FAO	Food and Agriculture Organization

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Author Contributions

Minkapieu Edwige Gueu-Kehi: Funding acquisition, Methodology

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The authors declare no conflicts of interest.

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Research Field

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