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Comparative Study of the Physicochemical Properties, of the minerals of two varieties of *Capsicum annuum*: The Hot Pepper and the Sweet Pepper cultivated in Korhogo in the North of Côte d'Ivoire

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Abstract— *The Capsicum annuum pepper species consists of two (2) main varieties: hot pepper and sweet pepper. These two (2) varieties are eaten in Korhogo, in the north of Côte d'Ivoire. However, the hot pepper is consumed much more than the sweet pepper only because of its pungent taste due to the presence of capsaicin. These two (2) varieties of Capsicum annuum encounter problems of distribution and conservation. In addition, the populations do not know their compositions nor their nutritional values. This study is a valuation of the two (2) varieties of Capsicum annuum. Also, it will allow people to consume more sweet pepper if its nutritional value is good. The comparative study of their physicochemical properties, antioxidant and anti-nutrient contents revealed that the sweet pepper has a higher length (6.48cm ± 0.6), circumference (14.51cm ± 0.45) , mass (37.61g ± 4.41), humidity rate (91.48% ± 0.3), oxalate content (377.66 mg / 100g ± 13.22). Hot pepper, for its part, has a higher ash content (0.95% ± 0.11), lipids content (0.45% ± 0.04), proteins content (1.46% ± 0.16), fiber content (5.53% ± 0.06), total carbohydrate (9.14% ± 0.57), energy value (46.45Kcal / 100g ± 2.59), polyphenol content (200.41mg / 100g ± 40.07),phytates content (25.31mg / 100g ± 0.69).In addition, the pH (5.46 ± 0.04) of these two (2) varieties, the titratable acidity (3 meq / 100g ± 0.19), the content of reducing sugars (196.52mg / 100g ± 61 , 46), the total sugars content (3.58% ± 0.52), the vitamin C content (44.16mg / 100g ± 19.02), the flavonoids content (3.65mg / 100g ± 1, 4), the tannins content (19mg / 100g ± 3.62), are not significantly different at the 5% level. Regarding minerals, hot pepper and sweet pepper contain phosphorus (0.15% dm ± 0.015), potassium (0.34% dm ± 0.017), calcium (0.31% dm ± 0.006), magnesium (0.17% dm ± 0.003), copper (3.45ppm ± 0.62), iron (7.53ppm ± 0.488), manganese (0.64ppm ± 0.13), zinc (16.74ppm ± 1.155), sodium (11.13ppm ± 5.261), the contents of which do not vary significantly from one variety to another. This study showed that these two (2) varieties of Capsicum annuum have dietary fiber, vitamin C, minerals, natural polyphenols which are beneficial for the local population. Anti-nutrients can be inactivated by cooking.*

Keywords— ***Hot pepper, Sweet pepper, Capsicum annuum, Physicochemical properties, minerals.***

I. INTRODUCTION

Urban food is a major challenge for African cities today. To this end, in West Africa, rapid urbanization has favored the development of artisanal sectors for processing and marketing local agricultural products (Cheyns and Bricas, 2003) [1]. Among these products, condiments, spices, aromatics are widely used in the traditional diet of countries on the west coast of Africa. They are the subject of a large number of commercial transactions between different countries and are found in all local markets (Ndir et *al*., 2000) [2]. This is why today peppers are grown everywhere whenever conditions permit.

Pepper is a vegetable plant which represents a great interest at the global level both in terms of production and consumption (Bharath et al., 2013) [3]. For its generally spicy taste, pepper is well appreciated in human food. It is a fruit very rich in vitamin C depending on the variety of the pepper. It is adapted to tropical and subtropical conditions (tolerates heat well). Peppers are grown year round, but irrigation is necessary in the dry season. In Côte d'Ivoire, pepper cultivation is generally rainfed.

Pepper belongs to the genus Capsicum. The genus *Capsicum* includes 25 species, 5 of which are cultivated (*C. annuum*, *C. baccatum*, *C. pubescens*, *C. fructescens*, *C.chinense*). The *C. annuum* species is the most cultivated in the world and the most economically profitable (Chaux and Foury, 1994) [4].

Capsicum annuum is a species comprising various varieties producing fruits with the sweetest flavors with the most pungent flavors. Thus, this species is the source of sweet peppers and a large number of hot peppers (Perry et *al*., 2007) (5].

Sweet peppers are distinguished from hot peppers by their fruits that are generally larger (3 to 12 cm in diameter) and fleshy, and above all devoid of any pungent substance (capsaisin) (Pegon, 2009; Zaman, 2009) [6,7] . These fruits are swollen, unripe green, and red, orange, yellow, purple, white, blue, or brown when ripe. They have a sweet taste and aroma (Grubben and Denton, 2004) [8]. The hot peppers of this species vary in shape, but are usually elongated and ovoid, 2 to 16 cm long, or globose. They are generally red, sometimes orange or yellow, when ripe, with a smooth or slightly wrinkled wall, with a mild to very pungent flavor (Csilléry, 2006) [9].

However, in Korhogo in the north of Côte d'Ivoire, the two (2) varieties (hot peppers and sweet peppers) of the species *Capsicum annuum* are underexploited and the income collected by the actors, namely farmers and the market sellers are thin. Significant amounts of the two (2) varieties of *Capsicum annuum* rot in the distribution chain before being purchased by consumers. Conservation issues prevail in the distribution chain; better control of the physico-chemical and nutritional parameters could help ensure better profitability of the two (2) varieties of *Capsicum annuum*. In addition, the populations do not know the nutrients provided by these two (2) varieties nor their composition. In addition, hot pepper is consumed more than sweet pepper only because of its pungent taste due to capsaicin. This study will also allow people who can't stand the hot taste of hot peppers to consume more sweet peppers if it turns out that their nutritional value is as good as that of hot peppers.

The general objective of our study is to promote the two (2) varieties of the species *Capsicum annuum*: hot pepper and sweet pepper.

This study will consist of:

- Determine the physico-chemical properties of these two varieties of *Capsicum annuum*

-Determine their antioxidant, anti-nutrient and mineral content

-Compare the two varieties of the species *Capsicum annuum*

-Evaluate the nutritional value of the two peppers through these results

II. MATERIAL AND METHODS

2.1 Biological material

The biological material used consists of two varieties of the *Capsicum annuum* species: hot pepper and sweet pepper.

2.2 Methods

2.2.1 Sampling

The samples of the two (2) varieties of *Capsicum annuum* were purchased in three (3) markets of the city of Korhogo specifically the Sinistré market, the Koko market and the big market. For each market, 4kg of samples of each variety of *Capsicum annuum* were purchased from three different vendors (traders), which makes 12kg of each variety of peppers purchased per market, resulting in 36 kg of each variety of *Capsicum annuum* for all three markets. The samples were then sent to the laboratory for the various analyzes.

2.2.2 Physical Characterization of Hot and Sweet pepper (*Capsicum annuum*)

Five (5) physical parameters were assessed on the Hot or Sweet pepper fruits, namely length, circumference, mass, moisture, and ash. The length and the circumference of the full fruit were estimated using a meter tape. The fruit's weight was measured using a 2 digits scale (Sartorius,).

The method of determining moisture is that proposed by **AOAC (1990)** [10]. The moisture was assessed by drying 5 g of sweet pepper into an oven at 105 °C till constant weight resulted after 24 h. The ash content was measured by incinerating five (5) g of oven-dried pepper into a muffle furnace at 550 °C for 12 h (**AOAC (1990)**[10].

2 2 3 Chemical trend of the hot andsweet pepper fruits

2.2.3.1 Acidity

The acidity traits (pH and titratable acidity) were measured using **AOAC (1990)** method [10]. Ten (10) grams of crushed sample are slurried in 100 mL of distilled water. The solution obtained is filtered on filter paper (Whatman). The pH measurement is carried out directly by immersing the previously calibrated pH meter (HANNA) electrode in the filtrate obtained. Then, 10 mL of the filtrate are taken and this test sample is titrated with a solution of NaOH (0.1 N) in the presence of phenolphthalein until turning pink. The titratable acidity is given in mEq/100g of dried sample.

2.2.3.2 Total soluble carbohydrates and reducing carbohydrates contents

Ethanosoluble carbobydrates were extracted from 1 g of ground dried hot orsweet pepper with 20 mL of 80% (v/v) ethanol, 2 mL of 10% (m/v) zinc acetate and 2 mL of 10% (m/v) oxalic acid, according to the method of **Agbo et *al.* (1985)** [11]. The extract was centrifuged at speed of 3,000 rpm for 10 min. The ethanol residue was evaporated from the extract upon a hot sand bath. Then, the extracted total soluble carbohydrates were measured out using the method of **Dubois et *al.* (1956)** [12]. The operation consisted in adding 0.9 mL of distilled water, 1 mL of 5 % (m/v) phenol, and 5 mL of 96% sulfuric acid into 100 µL of extract, then measuring the absorbance at 490 nm with a spectrophotometer (PG instruments). For the reducing sugars, 1 mL of extract was processed with 0.5 mL of distilled water and 0.5 mL of 3, 5- dinitrosalycilic acid (**Bernfeld, 1955**) **[13].**prior to the recording of the absorbance from the final solution at 540 nm with a spectrophotometer (PG instruments). Calibrations were performed with standard solutions of glucose and sucrose for recovering the final total carbohydrates and reducing carbohydrates contents in the studied samples.

2.2.3.3 Lipids content

Lipids were quantified from 10 g of ground dried hot or sweet pepper sample by solvent extraction using 300 mL of n-hexane reagent and a Soxhlet device for 7 h (**AFNOR, 1986)[14].** The hexan-oil mixture resulted from the extraction was recovered and separated with a rotavapor apparatus (Heidolph). The difference between the sample weight before and after the experiment allowed the estimation of the lipids content.

2.2.3.4 Proteins content

Crude proteins content was determined as the total nitrogen using the Kjeldhal method **(AOAC, 1990)** [10]. Thus, 1 g of hot or sweet pepper mash was mineralized at 400 °C for 2 h, with adding of concentrated sulfuric acid (H_2SO_4) and potassium sulfate (K_2SO_4) catalyst. The mineralizate was diluted and distilled for 10 min. Thereafter, the distillate collected into a flask containing boric acid and methylen bromocresol reagents ion, was titrated for the total nitrogen using ammonium sulfate ($(NH_4)_2SO_4$). The crude protein content of the hot or sweet pepper was deduced from the nitrogen level using 6.25 as conversion coefficient.

2.2.3.5 Fibers content

The determination of the crude fibers content consisted in treatment of 2 g of ground hot orsweet pepper sample with 50 mL of 0.25 N sulfuric acid and 50 mL of 0.31 N sodium hydroxide and filtration of the resulting solution upon Whatman paper. The residue was dried for 8 h at 105 °C then incinerated at 550 °C for 3 h into ovens (**Wolff JP, 1968)[15].** The final residue was weighed as crude fibers and expressed in percentage.

2.2.3.6 Total carbohydrates content and energy value

Total carbohydrates and energy values were determined using calculation formulas (**FAO ,2002**)**[16]** accounting the moisture, fat, protein, ash contents and the energy coefficients for macromolecules.

$$TCC\ (\%) = 100-[P(\%) + M(\%) + F(\%)+A(\%)]$$

$$CEV\ (kcal/100g) = [(4\times P) + (9\times F) + (4\times C)]$$

With: TCC, total carbohydrates content; CEV, caloric energy value; P, protein content; M, moisture content; F, fat content; A, ash content; C, total carbohydrates content

2.2.3.7 Vitamin C content

The vitamin C was evaluated from thehot or sweet peppers using 2,6- dichlorophenol-indophenol (DCPIP) reagent (**AOAC, 1984)[17].** Ten (10) grams of ground dried hot or sweet pepper sample were dissolved into 40 mL of metaphosphoric acid-acetic acid solution (2%, w/v). The resulted mixture was centrifuged at 3,000 rpm for 20 min. Thus, the supernatant was recovered, added with boiled distilled water for 50 mL, and titrated with 2, 6- DCPIP solution (0.5 g/L) previously calibrated with a pure vitamin C solution

2.2.3.8 Oxalates content

The oxalate content was determined with the standard **AOAC method (1990)** [10]. Two (2) grams of ground

dried hot or sweet pepper sample were homogenized into 200 mL of distilled water and added with 20 mL of 6N hydrochloric acid (HCl). The mixture was heated in boiling water bath for 1 h, cooled, and filtered. Fifty (50) mL of the filtrate were then homogenized into 20 mL of 6 N HCl, and filtered again. The 2nd filtrate was treated with methyl red (0.1%, w/v), concentrated ammonia, heated, and filtered. The 3rd filtrate was boiled, treated with calcium chloride (5%, w/v) for the formation of calcium oxalate crystals, and then filtered once more. The residues deriving from the filtration steps were successively washed with distilled boiling water, dried into an oven; dissolved into 10 mL of diluted sulfuric acid, and titrated with 0.05N potassium permanganate solution

2.2.3.9 Phytates content

The phytates were measured according to the method processed by **Mohammed et *al.*** (1986) [18]. A slight ground hot or sweet pepper sample (0.5 g) was treated with 25 mL of TCA solution at 3% (w/v) and centrifuged at 3,500 rpm for 15 min. Five (5) mL of the supernatant was removed, treated with 3 mL of ferric chloride 1% (w/v) reagent, heated in a boiling water bath, cooled and also centrifuged at 3,500 rpm for 10 min. The 2nd supernatant was treated with 5 mL of 0.5N hydrochloric acid, 5 mL of 1.5N sodium hydroxide, heated in a boiling water bath and centrifuged once more at 3,500 rpm for 10 min. Thus, 1 mL of the final supernatant was added with 4.5 mL of distilled water and 4.5 mL of orthophenantroline reagent and then measured for the absorbance at 470 nm with a spectrophotometer against standard Mohr salt solution treated likewise and taken as phytates ferric control.

2.2.3.10 Polyphenols contents

The phenol compounds were extracted from hot or sweet pepper with methanol reagent. One gram of dried pepper sample was homogenized in 10 mL of methanol solution 70% (v/v). The resulting mixture was centrifuged at 1,000 rpm for 10 min. The pellet was recovered and treated likewise. The deriving supernatants were thus gathered into a marked flask and added with distilled water at 50 ml.

The total polyphenols content was measured using Folin-ciocalteu reagent, sodium carbonate solution (20% w/v) and distilled water (**Singleton et *al*, 1999)[19].** Essays were measured for their absorbance at 745 nm with a spectrophotometer against standard gallic acid solutions taken as polyphenols control.
The tannins content was deducted from the total polyphenols using vanillin reagent (**Bainbridge et *al*, 1996)[20].** Essays were measured for their absorbance at 500 nm with a spectrophotometer against standard tannic acid solutions taken as tannins control.

Flavonoids content was also determined from the total polyphenols using aluminum chloride (10% w/v), potassium acetate (1 M) and distilled water (**Meda et *al*, 2005)[21].** Essays were measured for their absorbance at 415 nm with a spectrophotometer against standard quercetin solutions taken as flavonoids control

2 2 4 Determination of minerals

The determination of the mineral elements was performed according to the **IITA method (1981)** [22]. Finely ground hot or sweet pepper sample (0.4 g) previously oven dried at 60 ° C was incinerated into a muffle furnace at 550 °C for 3 h. The resulting gray-white ash was cooled, added with 2 mL of half-diluted HCl, placed on a sand bath at 120 °C until full evaporation, and then ovened at 105 °C for a 1 h. The final dry extract was recovered with 2 mL of half-diluted HCl, filtered, and the resulting filtrate added with distilled water, and lanthanum chloride. The mineral elements in the solution were then measured using Atomic Absorption Spectrometry (AAS 20 type VARIAN).

2-2-5-Statistical Analysis

All analyzes were performed in triplicate, then data processed using Statistical Program for Social Sciences software (SPSS version 20.0, SPSS for Windows, USA). For each characteristic, the results were expressed as means followed by their standard deviations as parameters of data dispersion. A one-way analysis of variance (ANOVA 1) was also performed to test the effect of variety on the characteristics assessed, at the statistical significance level of 5%. For statistically different means, classification was performed with the Student-Newman-Keuls test.

III. RESULTS

3-1- Physical properties

The sweet pepper has a length (6.48cm ± 0.6), a circumference (14.52cm ± 0.45), a mass (37.61g ± 4.44), a humidity (91.48% ± 0, 3) higher compared to length (3.37cm ± 0.23), circumference (6.55cm ± 0.28), weight (3.44g ± 0.11), humidity (88 % ± 0.71) of the hot pepper. For the ashes, it is rather the hot pepper which has a higher content (0.95% ± 0.11) than that of the sweet pepper (0.55% ± 0.06). (Table I)

Table I : Physical parameters of the two varieties of the species Capsicum annuum

Parameters	Hot pepper	Sweet pepper	P-value
Length (cm)	3.37± 0.23[a]	6.48 ± 0.6[b]	0.001
Circumferences (cm)	6.55 ± 0.28[a]	14.52± 0.45[b]	0.000
Mass (g)	3.44 ± 0.11[a]	37.61 ± 4.44[b]	0.000
Humidity (%)	88 ± 0.71[a]	91.48 ± 0.3[b]	0.001
Ashes(%)	0.95 ± 0.11[b]	0.55 ± 0.06[a]	0.006

Per row, values followed by different superscript letters are statistically different at 5%. P-value: value of the statistical probability test.

3-2- Chemical properties

Hot pepper has a higher content of lipid (0.45% ± 0.04), of protein (1.46% ± 0.16), of fiber (5.53% ± 0.06), of total carbohydrate (9 , 14% ± 0.57) and a higher energy value (46.45Kcal / 100g) compared to the content of lipid (0.36% ± 0.01), protein (0.87% ± 0.14), fiber (2.43% ± 0.5), in total carbohydrates (6.74% ± 0.17), at the energy value (32.68Kcal / 100g ± 0.82) of sweet pepper.

The two (2) varieties of *Capsicum annuum* did not show significant differences at the 5% threshold for pH, titratable acidity, reducing sugar content and total sugar content. For these parameters, the respective general means are: 5.46 ± 0.04; 3mEq / 100g ± 0.19; 196.52 mg / 100g ± 61.46; 3.58% ± 0.52 (Table II).

TableI : Chemical parameters of varieties of the species Capsicum annuum

Parameters	Hot pepper	Sweet pepper	General average	P value
P^H	5.44 ± 0.01[a]	5.48 ± 0.06[a]	5.46±0,04	0.318
Titratable acidity (mEq/100g)	3.08 ± 0.08[a]	2.92 ± 0.25[a]	3±0,19	0.344
Reducing sugar (mg/100g)	175.13± 81.07[a]	217.92 ± 38.70[a]	196.52±61.46	0.456
Total sugar (%)	3.24± 0,32[a]	3.93 ± 0.45[a]	3.58±0,52	0.095
Lipids (%)	0.45± 0,04[b]	0.36 ± 0.01[a]		0.036
Proteins (%)	1.46± 0,16[b]	0.87 ± 0.14[a]		0.008
Fiber (%)	5.53± 0,06[b]	2.43 ± 0.5[a]		0.000
Total carbohydrate (%)	9.14± 0,57[b]	6.74± 0.17[a]		0.002
Energy value (Kcal/100g)	46.45 ± 2,59[b]	33.68± 0.82[a]		0.002

Per row, values followed by different superscript letters are statistically different at 5%. P-value: value of the statistical probability test.

3-3- Antioxidant and Antinutrient Content

Except for the contents of polyphenols, there are no statistical differences between the contents of antioxidants. However, there is a statistical difference between the levels of anti-nutrients. Indeed, the polyphenol content of hot pepper (200.41 mg / 100g ± 40.07) is higher than that of sweet pepper (125.91mg / 100g ± 8.46). In addition, the two (2) varieties of pepper studied do not show significant differences at the 5% threshold concerning the contents of vitamin C, flavonoids and tannins. For these characteristics, the respective general averages are: 44.16 mg / 100g ± 19.02; 3.65mg / 100g ± 1.40; 19mg / 100g ± 3.62. Regarding anti-nutrients, hot pepper has a higher phytate content (25.31mg / 100g ± 0.69) than that of sweet pepper (21.47mg / 100g ± 1.2) while sweet pepper has a higher oxalate content (377.66 mg / 100g ± 13.22) than that of hot pepper (301.89 mg / 100g ± 23.85) (Table III).

Table II : Antioxidant and anti-nutrient content of varieties of the species Capsicum annuum

Parameters		Hot pepper	Sweet pepper	General average	P-value
Antioxidant content	Vitamin C (mg/100g)	46.94 ± 26.70[a]	41.39 ±12.99[a]	44.16±19.02	0.762
	Polyphenols (mg/100g)	200.41± 40.07[b]	125.91 ± 8.46[a]		0.035
	Flavonoids (mg/100g)	4.36 ± 1,36[a]	2.95 ± 1,3[a]	3.65±1,40	0.256
	Tannins (mg/100g)	21.07 ± 3.90[a]	16.94 ± 2.2[a]	19±3.62	0.185
Anti-nutrient content	Oxalate (mg/100g)	301.89±23.85[a]	377.66±13.22[b]		0.009
	Phytate (mg/100g)	25.31 ± 0,69[b]	21.47± 1,2[a]		0.009

Per row, values followed by different superscript letters are statistically different at 5%. P-value: value of the statistical probability test.

3 4. Mineral content

The hot pepper and the sweet pepper of Capsicum annuum contain phosphorus, potassium, calcium, magnesium, copper, iron, manganese, zinc, sodium, the contents of which do not vary significantly at the threshold of 5 % from one variety to another. The respective general means are (0.15% d.m ± 0.015); (0.34% d.m ± 0.017); (0.31% d.m ± 0.006); (0.17% d.m ± 0.003); (3.45ppm ± 0.62); (7.53ppm ± 0.488); (0.64ppm ± 0.13); (16.74ppm ± 1.155); (11.13ppm ± 5.261).

Table IV : Mineral content

Parameters	Hot pepper	Sweet pepper	General average	P-value
Phosphorus (%d.m)	0.16±0.02[a]	0.14±0.006[a]	0.15±0.015	0.345
Potassium (%d.m)	0.34±0.018[a]	0.35±0.02[a]	0.345±0.017	0.779
Calcium (%d.m)	0.31±0.009[a]	0.31±0.003[a]	0.31±0.006	0.67
Magnesium (%d.m)	0.17±0.003[a]	0.17±0.004[a]	0.17±0.003	0.422
Copper (ppm)	3.6±0.79[a]	3.31±0.52[a]	3.45±0.62	0.59
Iron (ppm)	7.35±0.67[a]	7.71±0.21[a]	7.53±0.488	0.432
Manganese (ppm)	0.66±0.2[a]	0.63±0.05[a]	0.64±0.13	0.812
Zinc (ppm)	17.18±1.66[a]	16.31±0.06[a]	16.74±1.155	0.415
Sodium (ppm)	9.77±3.85[a]	12.49±6.99[a]	11.13±5.261	0.587

Per row, values followed by different superscript letters are statistically different at 5%. P-value: value of the statistical probability test.

IV. DISCUSSION

The study showed a greater size, circumference and mass of the sweet pepper compared to the size, circumference, and mass of the hot pepper. The sweet pepper therefore has larger dimensions than those of the hot pepper; this was also observed by Pegon in 2009 [6] and Zaman in 2009 [7]. However, these dimensions are smaller than those of the eggplant *Solanum melogena* (15.51cm ± 1.73 for the size; 17.77cm ± 0.66 for the circumference; 161.21g ± 33.82 for the mass) studied by Niamke et *al* in 2019 [23].

The two varieties of *Capsicum annuum* have very high humidity percentages, over 80% which are close to that of Lopez-Hernandez et *al.*, 1996) [24] who said that the water content of hot pepper is 91%. These values are also close to that revealed for the onion variety (*Allium cepa*) V1320 (89.06%) by Konate et *al*. 2017 [25]. The moisture content of peppers is disadvantageous for their storage since peppers could be subject to rapid postharvest change such as rotting. This phenomenon was already observed by Ali et *al* in 2010 [26] on the fruits of the palmyrah palm. The difference observed in the moisture percentage of the two varieties could be due to the variety and the water absorption capacity of each of the plants (Kouakou, 2017) [27].

For the pH and titratable acidity values, there is no significant difference at the 5% threshold for the two (2) varieties of Capsicum annuum. However, the pH of hot peppers and sweet peppers are higher than that of the local variety of tomato Gbogan in Benin (4.17) studied by Dossou et al in 2007 [28]. Coliforms of the Escherchia coli type can develop on both varieties of pepper since the minimum pH required for the development of such microorganisms is 4.3 according to Rozier et al, in 1985 [29]. It will therefore be necessary to wash the peppers well before consumption.

The two varieties of capsicum annuum pepper contain lipids (0.45% and 0.36%) whose contents are higher than those given by Ciqual in 2013 [30] for cooked spinach (0.14%) but are lower than that of Okouango et al. (2015) [31] for the leaves of Phytolaccado dodecandra or wild spinach (1.6%). According to Anses in 2021 [32], lipids play two (2) major roles: an energy storage role and a structural role (enter into the composition of cells).

The two varieties of *Capsicum annuum* show a significant difference at the 5% threshold for protein content. These levels are lower than those of the two eggplant varieties *S. aethiopicum gilo* (1.68 ± 0.04) and *S. melogena* (1.81 ± 0.06) given by Niamke et *al* in 2019 [23] and the level obtained by Okouango et *al*. (2015) [31] for cassava leaves which was 7%. Proteins are essential to the body, they play a structural role (at the muscular or even skin level) but are also involved in a large number of processes such as the immune response (antibodies), the transport of oxygen in the organism (hemoglobin) or digestion (digestive enzymes) (ANSES, 2021) [32].The protein contents expressed by the two varieties studied could be explained by the effects of light and the adsorption of N03 by the roots (Guéguen, 1959) [33]. In fact, during the growth of the plant, it draws nitrogen from the soil in the form of N03 through its roots. The amount of nitrogen absorbed will depend on the needs of the plant related to the variety. And this quantity tends to increase or decrease with the degree of adsorption of light, of C02 during respiration, which also takes into account the variety and the climate (Kouakou, 2017) [27].

The total carbohydrate contents of the two varieties (9.14% and 6.74%) are also higher than those recorded by Niamke et *al* in 2019 [23] on the eggplant varieties *S. aethiopicum gilo* and *S. melogena* (5.33% and 4.50%). These total carbohydrate contents are lower than that of sweet potato (28.5% according to the FAO in 1992) [34]. These two (2) varieties of *Capsicum annuum* contain carbohydrates which are compounds that provide energy for the functioning and maintenance of muscle cells, brain, red blood cells and other organs, etc. (Martin, 2000; Folin, 2005; Fredot, 2009). [35,36,37]

Obviously, peppers are vegetables and are not really used as a source of carbohydrates, fat and protein. Therefore, they are recommended in diet, as foods with low calorie content. It is in this sense that Hobbs (1994) [38] reported that consumption of Capsicum helped to lose weight in obese people.

The peppers studied also contain fibers of different contents (5.53% and 2.43%). The fiber contents of cooked spinach (2.7%) and cooked green beans (4%) (Ciqual, 2013) [30] are intermediate between the two fiber contents of peppers. But the fiber content of peppers is lower than those observed by Kouakou in 2017 [27] for the leaves of three varieties of cassava (*Manihot esculenta Crantz*), the average value of which is 8.15%. These two varieties of peppers could be a significant source of dietary fiber, which is eliminated more slowly from the stomach and thus improves intestinal transit. These dietary fibers are absolutely essential for the balance of the digestive tract and that of the body. They represent a factor of good health. Studies have shown an inverse correlation between the consumption of dietary fiber and colon cancer. In fact, fibers have the capacity to complex with carcinogenic molecules, thus preventing their contact with the colon and facilitating their excretion (Jansen et al., 1999; Chene, 2003) [39,40]. Consumption of the two (2) varieties of *Capsicum annuum* could therefore increase gastric volume

and constitute a post-ingestive state making it possible to reach a state of satiety more quickly (Chene, 2003; Al-Dobaib, 2009) [40,41]. Fiber generally reduces blood glucose, HDL-cholesterol and LDL-cholesterol levels and thus helps reduce coronary heart disease (Jalili et al., 2000) [42].

The polyphenol composition differs from the two varieties of peppers. The differences obtained may be due to the variability in chemical composition (Pino et al., 2005) [43]. These discrepancies may also be due to the growth stage of the plants studied and / or the collection season, to the nature of the sampling site (Salem, 2005) [44].

The presence of antioxidants may also reflect a response to stress (scarcity of rainfall, unfavorable soil quality which is associated with an increase in the level of tannins) (Mebirouk-Boudechiche et al., 2014) [45]. Thus, depending on the efforts made to adapt to environmental conditions by the plant, the amount of antioxidant decreases or increases. The measured vitamin C of the two varieties of Capsicum annuum is on average 44.16 mg / 100g. This value is higher than those observed by Niamke et al in 2019 [23] for eggplants S aethiopicum gilo (9.08mg / 100g) and S melogena (9.85mg / 100g). This value is also slightly higher than that of grapefruit (40.9 mg / 100g) and lower than that of lemon (129 mg / 100g) (Pilège, 2021) [46].

Vitamin C plays several roles in the body. It contributes to the health of bones, cartilage, teeth and gums. It also protects against infections, accelerates wound healing and promotes iron absorption. In addition, it participates in the metabolism of hormones and drugs, and in the degradation of cholesterol reported by Mourey, 2004 [47]. Polyphenols have many health benefits, such as reducing cardiovascular, inflammatory or neurodegenerative diseases, preventing cancer, antiplatelet effects, regulating blood pressure, etc. (Achat S, 2013) [48]. The flavonoid contents (3.65 mg / 100g on average) are interesting, flavonoids can neutralize free radicals and reduce the risk of cancer by stopping cell growth in tumors (Wang et al, 2014) [49].

Hot peppers and sweet peppers contain anti-nutritional compounds: oxalates and phytates. These compounds modify the digestibility of nutrients (antiproteases), they are also chelators which reduce the bioavailability of minerals (Weston Petroski and Deanna M. Minich, 2020) [50]. On the other hand, food preparation methods, especially cooking or heat treatment, are the most effective way to inactivate them (Matthias Schulze et al, 2018) [51].

The studies carried out have shown that the two varieties of Capsicum annuum contain minerals (phosphorus, potassium, calcium, magnesium, copper, iron, manganese, zinc, sodium) whose contents do not vary significantly at the 5% threshold of a variety to the other. A diet containing calcium and phosphorus is a factor in preventing osteoporosis and also a factor in reducing the risk of arterial hypertension, colon and prostate cancer (Bonithon-Kopp et al, 2000) [52]. Potassium is a mineral that increases cardiovascular well-being. Just like magnesium recommended for the prevention of certain complications of myocardial infarction (Kannel et al, 1997; Chow, 2009 [53,54]). Iron plays a major role in the production and functioning of hemoglobin, iron is also involved in the constitution of myoglobin, the protein responsible for oxygenating the muscles; zinc is important in the phenomena of cell renewal, healing and immunity; selenium generally contributes to the body's defense reactions (ANSES, 2017) [55]. Manganese is essential for the metabolism of amino acids, carbohydrates and lipids, it participates in the production of insulin (Florence Daine, 2017) [56].

V. CONCLUSION

It emerges from this study on the two varieties of the species *Capsicum annum*, that the hot pepper has a content of ash, lipids, proteins, fibers, total carbohydrates, energy value, polyphenols, phytate, more high. Sweet peppers, on the other hand, have a higher length, circumference, mass, and moisture content, oxalate. Moreover, for these two varieties of peppers, there are no significant differences concerning the contents of pH, titratable acidity, reducing sugars, total sugars, vitamin C, flavonoids, tannins, minerals. Ultimately, these two (2) varieties of *Capsicum annuum* contain macronutrients such as carbohydrates, proteins, lipids and in addition they have fiber, vitamin C, polyphenols, flavonoids, minerals which are beneficial for populations. Anti-nutrients are inactivated by cooking.

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