Chemical Characterization and Anti-Radical Activity of Fruits and Vegetables Commonly Consumed in Brazzaville

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How to cite this paper: Tsiba, G., Yoca, J.E., Blondy, M.-B., Thimoleon, A.-B. and Ongoka, E.P. (2020) Chemical Characterization and Anti-Radical Activity of Fruits and Vegetables Commonly Consumed in Brazzaville. *Food and Nutrition Sciences*, **11**, 773-788.
https://doi.org/10.4236/fns.2020.118055

Received: July 18, 2020
Accepted: August 15, 2020
Published: August 18, 2020

Abstract

The objective of this study was to analyze ten (10) species of edible vegetables and nine (9) fruit commonly found in Congo (Brazzaville) in order to determine their total polyphenol content (TPC) and total flavonoid content (TFC), and their antiradical activity by the method of 1,1-diphenyl-2-picrylhydrazyl (DPPH). The results obtained showed that the highest TPC and TFC were found, on the one hand, in the extracts of four species of vegetables, *i.e. Ipomoea batatas L.* (536.02 ± 0.01 mg of GAE/100 g DW; 486.46 ± 0.10 mg of QtE/100 g DW), *Cucurbita pepo* (533.60 ± 0.05 mg of GAE/100 g DW; 303.72 ± 0 mg of QtE/100 g DW), *Hibiscus sabdariffa* (421.02 ± 0.015 mg of GAE/100 g DW; 243.49 ± 0.10 mg of QtE/100 g DW), *Solanum negrum* 1 (412.10 ± 0.05 mg of GAE/100 g DW; 292.10 ± 0.14 mg of QtE/100 g of DW) and, on the other hand, in the extracts of two species of fruit, *i.e. Chrysophyllum lacourtianum* (532.79 ± 0.19 mg of GAE/100 g of DW; 380.55 ± 0.10 mg of QtE/100 g of DW) and seeds of *Aframomum alboviolaceum* (469.38 ± 0.28 mg of GAE/100 g DW; 107.27 ± 0.10 mg of QtE/100 g DW). The lowest TPC and TFC were obtained with the extracts of *Brassica campestris* and of *Spinacia oleracea*, respectively 97.78 ± 0.17 GAE mg/100 g DW and 27.52 ± 0.10 QtE mg/100 g DW. The extract of the *Saba senegalensis* pulp had the lowest TPC and TFC. In addition, the highest antiradical activity was observed with extracts from vegetables and fruit with high TPC and TFC. The results indicate that these vegetables and fruit could be potential sources of the phenolic compounds and the biomolecules having several biological ac-

tivities. Thus, their consumption might be an alternative in the prevention of chronic diseases.

Keywords

Fruit, Vegetables, Polyphenols, Flavonoid, Antiradical Activity

1. Introduction

Food and dietary habits play an important role in the prevention of chronic diseases. Fruit and vegetables are undoubtedly crucial for a healthy diet and balanced. The diets rich in fruit and vegetables are also related to a reduction of the risk of diseases [1] [2]. The consumption of a 400 - 600 g portion of fruit and vegetables per day is recommended by World Health Organization (WHO), Food and Agriculture Organization (FAO) and the World Cancer Research Fund [3] [4] [5] [6], and it can reduce the global burden of disease [7].

Epidemiological investigations of previous studies [8] [9] [10], have shown that diets rich in fruit and vegetables have beneficial effects against common chronic diseases caused by oxidative stress such as cancer, obesity, cardiovascular and neurodegenerative diseases. The health benefits of fruit and vegetables have been partially attributed to their phenolic compounds, which have received particular attention due to their antioxidant properties [11] [12]. In effect, fruit and vegetables are a true important source bioactive substance including polyphenolics of polyphenolic compounds and provide desirable benefits for animal health beyond basic nutrition [13] [14] [15] [16]. Dietary polyphenol intakes from fruit and vegetables are well known to lower the risk of several oxidative stresses including cardiovascular diseases, cancer, stroke and coronary heart [17] [18].

These polyphenolic compounds have a wide range of biological activities *in vitro*, including anti-allergic, anti-atherogenic, anti-inflammatory, anti-microbial, anti-thrombotic, cardioprotective and vasodilatory actions, related of their hydrogen and electron donating abilities and metal chelating effects [2]. In addition, owing to the presence of the conjugated ring structures and hydroxyl groups, several phenolic compounds can potentially function as antioxidants by scavenging superoxide anion, singlet oxygen and lipid peroxyl radicals by stabilizing free radicals involved in oxidation processes through or combining with oxidizing species [19].

The antioxidant properties of these compounds allow them to inhibit the oxidation in both the dietary (oxidation of lipoproteins) and physiological (oxidative stress) fields [20]. They are capable of preventing the oxidation of Low Density Lipoproteins (LDL) and could thereby protect the organism against myocardial infarction or coronary atherosclerosis, which are associated high levels cholesterol of level LDL circulating in the blood [21], and to reduce free radicals that are often the cause of the oxidative stress [22]. These substances are of great in-

terest in several areas, including nutrition by their preventive nature with regard to various diseases as mentioned above, cosmetology and especially the food industry through their implication, in particular, on the flavor of food and their impact on the preservation of food products [23] [24]. Thus, fruit and vegetables containing them could constitute an alternative to the use of synthetic food additives which have shown harmful effects [25]. In view of these advantages, the consumption of fruit and vegetables should be encouraged to curb these chronic pathologies. However, their consumption is very low worldwide, with the lowest consumption reported in Sub-Saharan Africa [6]. Low fruit and vegetable consumption are synonymous with an unbalanced and unhealthy diet, which can be linked to various diseases and in the worst cases associated with increased mortality rates. The poverty is one of the main factors contributing to low fruit and vegetable consumption in developing countries, and this is also the case in the Republic of Congo. However, Sub-Saharan Africa in general, and the Republic of the Congo in particular, is endowed with several endemic species of fruit and vegetables that could be exploited in the diet and help solve some problems related to chronic diseases. Despite these advantages, very few studies on their characterization as bioactive compounds, especially polyphenols, have been carried out up to now.

It is with this in mind that we were interested in nine (9) fruit, *i.e. Annona muricata L*, *Citrus reticulata L*, *Aframomum giganteum*, *Saba senegalensis*, *Anisophyllea quangensis Engl. Ex henriq*, *Chrysophyllum lacourtianum*, *Passiflora quadrangularis*, *Aframomum alboviolaceum et Ficus capensis Thumb* and ten (10) vegetables: *Ipomoea batatas* L, *Spinacia oleracea*, *Hibiscus sabdariffa*, *Amaranthus*, *Solanum nigrum* (1), *Dioscorea liebrechtsiana De Wild*, *Solanum melongena L*, *Cucurbita pepo L*, *Brassica campestris L*, *Solanum nigrum* (2), commonly consumed in Brazzaville so as to measure the quantitative potential of total polyphenols, and then evaluate subsequently the antioxidant power of the various hydro-ethanol extracts of these fruit and vegetables.

2. Materials and Methods

2.1. Plant Material

The plant material for this study consists of the fruit and vegetables, presented in Table 1 and Table 2, which were, on the one hand, harvested in the "ex-Tele zone" in the first district Makélékélé of Brazzaville and, on the other hand, purchased at the "Total market" in the second district and the "Lycée Thomas Sankara market" in the ninth district of Brazzaville. The different plants were identified by Dr. Jean Marie MOUTSAMBOTE from the National Institute for Research in Exact and Natural Sciences (IRENS) of Brazzaville (Congo).

2.2. Reagents

2,2-diphenyl-1-picrylhydrazyl (DPPH), Quercetin and Folin-Ciocalteu were purchased from Sigma Aldrich. Gallic acid was obtained from Merck.

Table 1. The different vegetables used for analyses.

Systematic names	Pictures of vegetables	Popular names	Organs used
Ipomoea batatas L.		Matembelé	leaves
Spinacia oleracea		Spinach	leaves
Hibiscus sabdariffa		Oseille	leaves
Amaranthus		Bary	leaves
Solanum nigrum 1		Moussosso 1	leaves
Dioscorea liebrechtsiana De Wild		Ntinia	seedling
Solanum melongena L		Eggplant	Fruit
Cucurbita pepo L		Ngapara	leaves
Brassica campestris L		Loundif	leaves
Solanum nigrum 2		Moussosso 2	leaves

Table 2. The different fruit used for analyses.

Systematic names	Pictures of vegetables	Popular names	Organs used
Annona muricata L		Corossol	Pulp
Citrus reticulata L		Mandarin	Pulp
Aframomum giganteum		Tondolo 1	Pulp and seeds
Saba senegalensis		Malombo	Pulp
Anisophyllea quangensis Engl. Ex henriq		Bila Esobé	Pulp
Chrysophyllum lacourtianum		Bamou	Pulp
Passiflora quadrangularis		Barbadine	Pulp
Aframomum alboviolaceum		Tondolo 2	Pulp and seeds

2.3. Sample Processing

The different fruit and vegetables collected were carefully washed with tap water and the organs used were: pulp and seeds for fruit, leaves and seedling for vegetables. The organs of the different fruit were then dried in an oven at 40˚C and those of the vegetables at room temperature away from light for 7 days until their mass had stabilized. The dried organs were crushed and the powder obtained was stored before the various analyses.

2.4. Preparation of the Different Extracts

The extracts for determining of total polyphenols and flavonoids, and antiradical activities were obtained by mixing 30 g of the plant material in 2 × 150 mL of the hydro-ethanol solution of a 50% (v/v). The mixture was stirred for 72 hours, and then filtered. The filtrate obtained was concentrated dry from a rotary evaporator and stored in a cold place (+4˚C) awaiting analysis [25].

2.5. Determination of the Total-Polyphenol Content

The determination of total polyphenol content (TPC) was carried out using Folin-Ciocalteu colorimetric method described by Muanda *et al.* [26]. This quantitative assay was performed by mixing in an Eppendorff tube 0.1 mL of the hydroethanolic extract (2 mg/mL), 0.9 mL of distilled water and 0.9 mL of the Folin-Ciocalteu reagent (1N), and then immediately following 0.2 mL of a 20% sodium carbonate (Na_2CO_3) was added. The absorbance of the obtained mixture was measured at 760 nm employing a spectrophotometer after incubation for 40 min at room temperature in the dark against a methanol solution used as a blank. Quantification was conducted on the basis of a standard curve of gallic acid analyzed under the same conditions as the samples. Results are expressed as milligrams of gallic acid equivalent (GAE) per 100 grams of dry weight (GAE/100 g DW).

2.6. Determination of Total Flavonoid Content

The total flavonoid content (TFC) was determined using the colorimetric method described by Muanda *et al.* [26]. For this purpose, 250 µL of the hydro-ethanol extract and 1 mL of water were introduced successively into a 10 mL flask. At the initial time (0 minutes), 75 µL of a 5% sodium nitrite solution was added. After 5 minutes, 75 µL of a 10% aluminium trichloride solution was added. At 6 min, 500 µL of sodium hydroxide (1N) was added to the mixture. Immediately, 2.5 mL of distilled water was added to the mixture. The absorbance of the mixture obtained was measured at 510 nm with the UV-visible spectrophotometer. A calibration curve was drawn up using standard solutions of quercetin prepared at different concentrations. The TFC was calculated and expressed as a quercetin equivalent [milligrams of quercetin equivalent (QtE) per 100 grams of dry weight (QtE/100 g DW)].

2.7. Evaluation of Anti-Radical Activity

The DPPH radical scavenging activity was determined using the method described by Hennebelle [27] The test solution was performed by mixing 10 mL of a 10 mg/250 ml of 2,2-diphenyl-1-picrylhydrazyl (DPPH) solution with 100 µL of the test extract at different concentrations (5 to 50 mg/mL). The activity was then measured at 517 nm employing a spectrophotometer UV-visible after a 30 minute-incubation in the dark. The percentage of inhibition of DPPH was calculated by the following relationship:

$$\%\,\text{inhibition} = \frac{(\text{ABlank} - \text{ASample})}{(\text{ABlank})} \times 100$$

ABlank: Absorbance of Blank; ASample: Absorbance of sample.

The IC50 was determined by evaluating the free radical scavenging activity of several dilutions of each sample and interpolating the extract concentration whose inhibition percentage reached 50%. The IC50 value was calculated from the graph plotting the scanning activity for the selected fruits and vegetables.

2.8. Statistical Analysis

All tests were performed in triplicate. The statistical analyses were carried out with R software version 3.3.3. The Pearson's Chi-squared test was used to compare two by two the measured parameters (TPC, IC50 and TFC) of fruit and vegetables. All tests had a significance level of 5%.

3. Results and Discussion

3.1. Total Polyphenol Content (TPC) of Different Extracts of Vegetables

The regression equation from calibration curve of galic acid was of Y = 3.9089x + 0.1257, with a correlation coefficient: R^2 = 0.9989. The TPC expressed in mg GAE/100 g DW are shown in **Figure 1**. These results show that TPC vary in different vegetable extracts.

In **Figure 1**, we can see that the highest TPC values were found in the extracts of *I. batatas* and *C. pepo*, which were respectively 536.02 ± 0.01 and 533.60 ± 0.05 mg of GAE/100 g DW, and they are statistically identical (P > 0.05). Followed of the extracts of *H. sabdariffa* (421.02 ± 0.015 mg of GAE/g DW) and *S. negrum* 1 (412.10 ± 0.05 mg of GAE/g DW), that are also statistically identical (> 0.05). Ours values were generally higher than the ones reported by Yadav *et al.* [15], especially in methanolic, ethanolic and butanolic extracts of *C. pepo* which were respectively 519.81 ± 2.35, 336.25 ± 1.52 and 272.01 ± 1.57 mg of GAE/100 g DW, and in the ethanol extracts of six other varieties of gourd leaves, *i.e. Cucurbita maxima* (56.11 ± 0.69 mg of GAE/100 g DW), *Trichosanthes dioica* (118.82 ± 1.11 mg of GAE/100 g DW), *Luffa acutangula* (156.23 ± 2.02 mg of GAE/100 g DW), *Lageneria siceraria* (463.64 ± 1.37 mg of GAE/100 g DW), *Momordica. charantia* (440.79 ± 2.12 mg of GAE/100 g DW) and *Lageneria cylindrica* (300.06 ± 2.51 mg of GAE/100 g DW). Extracts of *Amanranthus* (194.79 ± 0.03

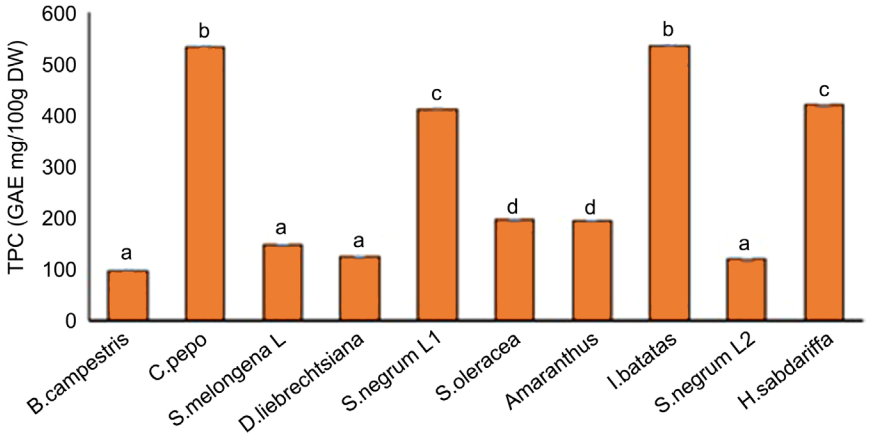

Figure 1. Total Polyphenol Content (TPC) of different hydro-ethanol extracts from studied vegetables. When the letters above the bars are identical, the averages are identical (at the 5% threshold). Otherwise, the averages are significantly different (at the 5% threshold).

mg of GAE/100 g DW) and *S. oleacea* (196.79 ± 0.03 mg of GAE/100 g DW) had mean TPC that were statically identical ($P > 0.05$), while those of *S. negrum* 2 (120.09 ± 0.03 mg of GAE/100 g DW), *S. melongena* (147.30 ± 0.11 mg of GAE/g DW), *B. campestris* (97.78 ± 0.17 mg of GAE/100 g DW) and *D. liebrechtsiana* De Wild (124.7 ± 0.01 mg of GAE/100 g DW) had relatively low TPC and did not show significant differences ($P > 0.05$).

3.2. Total Polyphenol Content (TPC) of Different Extracts of Fruit

Results showing the total polyphenol contents (TPC) determined in the hydroethanolic extracts of edible fruits are presented in **Figure 2**. Regarding this Figure, the extract TPC of *C. lacourtianum* (532.79 ± 0.19 mg of GAE/100 g DW) and the seeds of *A. alboviolaceum* (469.38 ± 0.28 mg of GAE/100 g DW) were much higher than those of any other fruit under study. However, the extract of *C. lacourtianum* showed significantly ($P < 0.05$) higher value of TPC than the one of *A. alboviolaceum.* It should be noted that those values were considerably higher than the ones of *Ficus carica* (331.93 ± 51.19 mg/100 g MS), *Prunus armenidca* (304.63 ± 38.84 mg/100 g MS), *Phoenix dactylifera* (241.61 ± 50.48 mg/100 g MS) and *Prunus amygdalus* (109.07 ± 15.96 mg/100 gMS) dry fruit of commonly consumed in India reported by Vijaya Kumar Reddy *et al.* [14], and similar to those found in fruit regularly consumed in the Malaysia such as *Baccaurea polyneura* (546.25 ± 15.70 mg of GAE/100 g), *Mangifera odorata* (487.00 ± 8.23 mg of GAE/100 g) and *Syzygium jambos* (555.57 ± 28.33 mg of GAE/100 g) published by Ikram *et al.* [28], and to other dried fruit consumed in Algeria, such as apricots and figs, with values of 630 mg GAE/100 g DW and 520 mg GAE/100 g DW, respectively [29].

In addition, we noted not negligible TPC in extracts of *C. reticulata*, *P. quadrangularis* and *A. alboviolaceum* (P + S), with values 186.89 ± 0.05, 106.12 ±0.07 and 93.23 ± 0.11 mg of GAE/100 g DW, respectively. The value for *C. reticulata* is

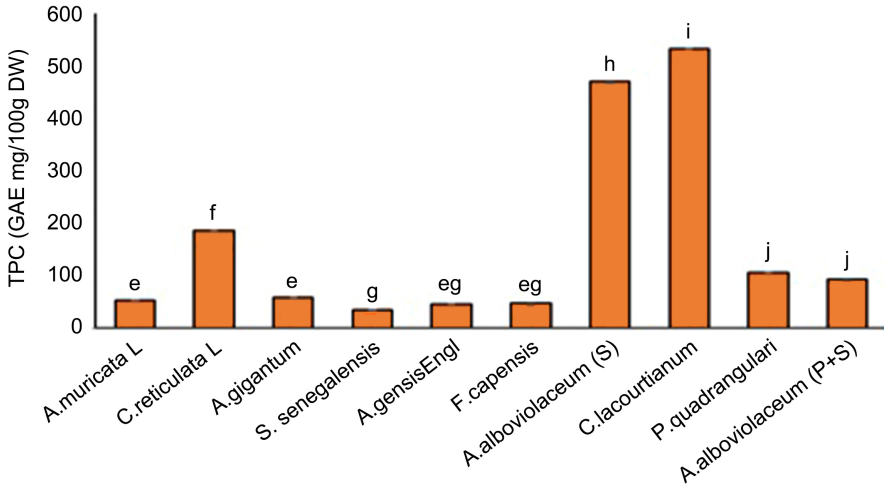

Figure 2. Total Polyphenol Content of different hydro-ethanol extracts from studied fruit. S = seeds, P = pulp. When the letters above the bars are identical, the averages are identical (at the 5% threshold). Otherwise, the averages are significantly different (at the 5% threshold).

statistically different from two other extracts (P-value < 0.05), which are statistically identical (P-value > 0.05).

The low TPC were obtained with extracts of *A. muricata* (54.24 ± 0.13 mg GAE/100 g DW), *A. gigantum* pulp and seed (59.65 ± 0.09 mg GAE/100 g DW), *S. senegalensis* (35.46 ± 0.15 mg GAE/100 g DW), *A. gensisEngl* (46.75 ± 0.2 mg GAE/100 g DW) and *F. capensis* (47.56 ± 0.15 mg GAE/100 g DW). We observed a significant variation (P < 0.05) between the mean of *S. senegalensis* and those of *A. muricata* and *A. gigantum*, which are statistically identical (P-value > 0.05) to the ones of *A. gensisEngl* and *F. capensis*. In addition, the TPC value of *S. senegalensis* pulp is very low compared to that obtained by Lamien-Meda *et al.* [7] on the acetone (872.33 mg GAE/100 g) and methanol (505.83 mg GAE/100 g) extracts from the same fruit. This difference could be explained by the climate as well as the extraction solvent used.

3.3. Total Flavonids Content (TFC) of Different Extracts of Vegetables

The regression equation from calibration curve of quercetin was of Y = 1.6954x + 0.2816, with a correlation coefficient: R^2 = 0.9955. The TFC of the extracts of the different vegetables expressed in mg QtE/100 g DW are presented in **Figure 3**.

In this figure, we observe that the extract of *I. batatas* (486.46 ± 0.10 mg of QtE/100 g DW) had a far (P < 0.05) higher TFC than the other extracts. Followed by *C. pepo* (303.72 ± 0.10 mg of QtE/100 g DW) and *S. negrum* 1 (292.10 ± 0.14 mg of QtE/100 g DW) extracts, and finally *H. sabdariffa* (243.49 ± 0.10 mg of QtE/100 g DW). The extracts of *S. melongena L*, *D. liebrechtsiana De Wild*, *Amaranthus*, *S. nigrum L2*, *B. campestris* and *S. oleracea* presented the lowest TFC, with values of 95.08 ± 0.04; 74.24 ± 0.12; 59.70 ± 0.10; 52.43 ± 0.20;

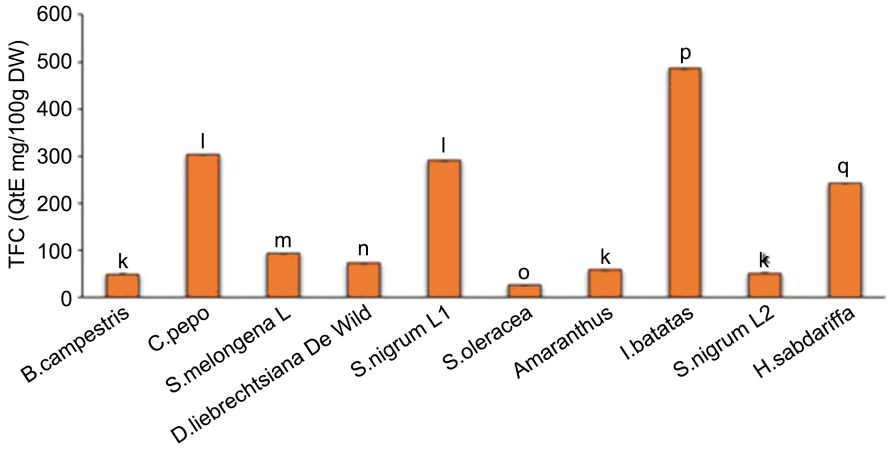

Figure 3. Total Flavonoid Content (TFC) of different hydro-ethanol extracts from vegetables. When the letters above the bars are identical, the averages are identical (at the 5% threshold). Otherwise, the averages are significantly different (at the 5% threshold).

50.36 ± 0.10 and 27.52 ± 0.10 mg of QtE/100 g DW, respectively. Nevertheless, our values were higher than or similar to the ones found by Yadav *et al.* [15] on the ethanol extracts of seven varieties of squash with values between 3.73 ± 0.22 and 84.85 ± 0.35 mg of QtE/100 g DW.

3.4. Total Flavonoid Content (TFC) of Different Hydro-Ethanol Extracts from Fruit

The results were expressed as quercetin equivalents using the regression equation from the standard curve of quercetin, $Y = 1.6954x + 0.2816$; $R^2 = 0.9955$. **Figure 4**, presenting the TFC results of the extracts of the different selected fruit, shows that the highest TFC was observed in the extract of *C. lacourtianum* (380.55 ± 0.10 mg of QtE/100 g DW), with significant variations (P-value < 0.05) than the other fruit, followed of the extract of *A. alboviolaceum* seeds (107.27 ± 0.10 mg of QtE/100 g DW). Extracts from *C. reticulata L* (64.89 ± 0.03 mg EQt/100 g DM) and *P. quadrangularis* (59.70 ± 0.01 mg EQt/100 g DM) revealed low TFCs which were significantly different (P < 0.05), with non-significant variations (P > 0.05). In addition, lowest TFC values with not significant variations (P > 0.05) were recorded for *A. gigantum*, *A. muricata L*, *A. gensisEngl*, *A. alboviolaceum* (P + S), *F. capensis* and *S. senegalensis*, with values of 36.86 ± 0.03; 34.78 ± 0.05; 31.70 ± 0.03; 31.67 ± 0.01; 28.55 ± 0.1 and 23.36 ± 0 mg of QtE/100 g DW, respectively. When comparing with the work by Benmeddour *et al.* [30] on the TFCs of ten Algerian date cultivars, this study showed that, exception the *C. lacourtianum* fruit which had a high value, the other fruit presented TFC values within the value range of those ten date varieties (15.22 to 299.74 mg QE/100 g DW).

These results direct us towards the regular consumption of vegetables such as *I. batatas*, *C. pepo*, *H. sabdariffa* and *S. negrum* 1, and fruit such as *A. alboviolaceum* and *C. lacourtianum*, which are rich in total polypenolic compounds and total flavonoid. These fruit and vegetables could help to avoid disorders related to oxidative stress such as degenerative diseases [31], and provide protection

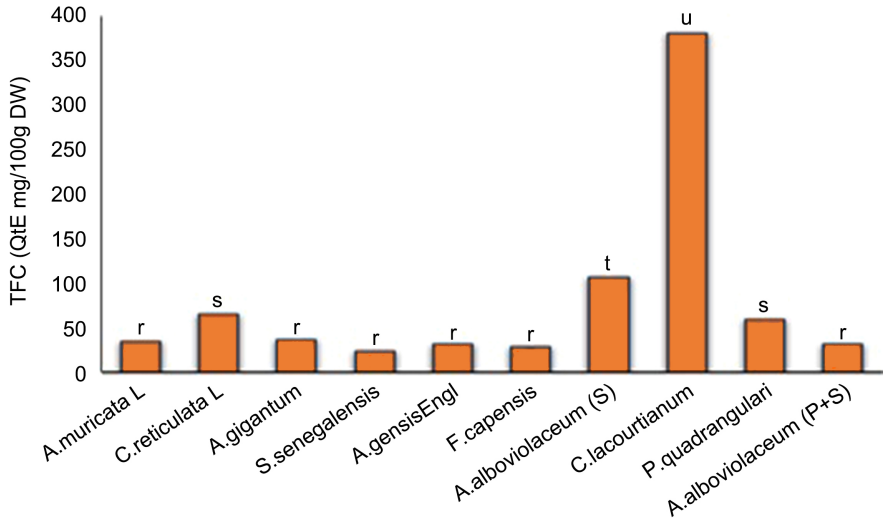

Figure 4. Total Flavonoid Content (TFC) of different hydro-ethanol extracts from fruit. S = seeds, P = pulp. When the letters above the bars are identical, the averages are identical (at the 5% threshold). Otherwise, the averages are significantly different (at the 5% threshold).

against oxidation at the cellular level by interfering in enzyme activity, chelation of redox active metals and free radical scavenging [32]. Dietary polyphenols may provide indirect protection by activating endogenous defence systems and modulating cell signaling processes such as NF-κB activation, AP-1 DNA binding, glutathione biosynthesis and various biochemical processes involved in the activation of carcinogenesis [33] [34]. In addition, phenolic compounds such as flavonoids are powerful free radical scavengers in fruit and vegetables. They protect lipids and vital cells from oxidative damage, participate in the prevention of coronary heart disease, and have antiproliferative or anticancer activities [35] [36] [37].

3.5. Evaluation of the Antiradical Activity of the Different Extracts Vegetables

The results of the anti-radical activity of extracts from vegetables are presented in **Figure 5**.

From the analysis of **Figure 5**, it appears that extracts *of S. nigrum L*1, *H. sabdariffa*, *I. batatas*, *S. oleracea* and *C. pepo* better inhibit free radicals with low inhibitory concentrations (IC50) of 12.33 ± 0.01; 12.86 ± 0.04; 14.20 ± 0.02; 18.27 ± 0.02 and 18.28 ± 0.02 mg/mL, respectively, followed by extracts of *S. nigrum L*2 (21.83 ± 0.1 mg/mL) and *D. liebrechtsiana De Wild* (23.06 ± 0.01 mg/mL), with not significant variations ($P > 0.05$). While extracts of *S. melongena*, *Amaranthus* and *B. campestris* inhibit less free radicals with the strengths of IC50 of 28.28 ± 0.08; 36.23 ± 0.04 and 42.08 ± 0.34 mg/mL, respectively, with not significant differences ($P > 0.05$).

3.6. Evaluation of the Antiradical Activity of the Different Extracts Fruit

Figure 6 presents the results of the antiradical activity of the studied fruit.

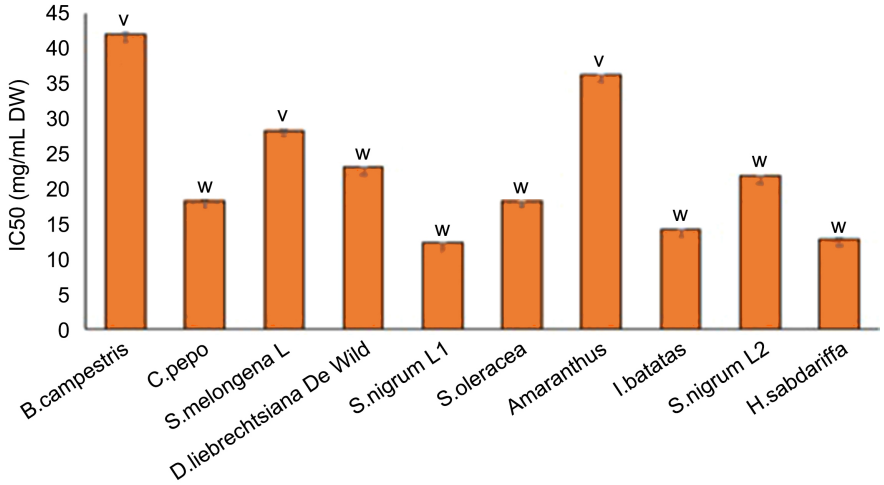

Figure 5. Inhibitory concentration 50 (IC50) of various vegetable extracts. When the letters above the bars are identical, the averages are identical (at the 5% threshold). Otherwise, the averages are significantly different (at the 5% threshold).

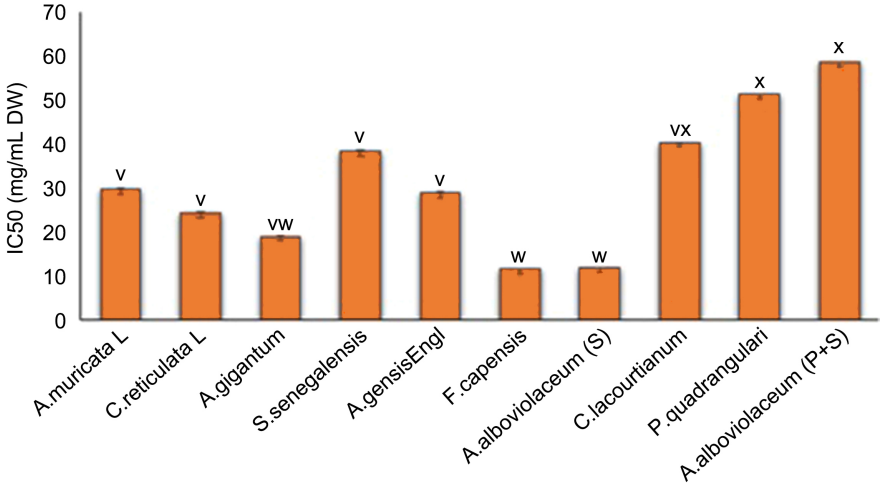

Figure 6. Inhibitory concentration 50 (IC50) of various fruit extracts. S = seeds, P = pulp. When the letters above the bars are identical, the averages are identical (at the 5% threshold). Otherwise, the averages are significantly different (at the 5% threshold).

It can be seen that extracts of *F. capensis*, *A. alboviolaceum* and *A. gigantum* strongly inhibit free radicals with respective IC50 of 11.47 ± 0.07 and 11.84 ± 0.07; 18.91 ± 0.11 mg/mL, followed by the extracts of *C. reticulata L* (24.21 ± 0.11 mg/mL), *A. gensisEngl* (28.90 ± 0.21 mg/mL) and *A. muricata L* (29.76 ± 0.20 mg/mL). The lowest anti-radical activity was observed with extracts of *S. senegalensis* (38.34 ± 0.20 mg/mL), *C. lacourtianum* (40.03 ± 0.03 mg/mL), *P. quadrangularis* (51.36 ± 0.02 mg/mL) and *A. alboviolaceum* (58.68 ± 0.08 mg/mL).

The results of this study show that vegetables such as *S. nigrum L*1, *H. sabdariffa*, *I. batatas*, *S. oleracea* and *C. pepo*, on the one hand, and fruit such as *F. capensis*, *A. alboviolaceum* and *A. gigantum* on the other hand, reduce free radicals better. This strong inhibition of free radicals could be justified by the relatively high concentrations of total polyphenols and flavonoids quantified in this

study. Indeed, polyphenolic compounds are reputed to be powerful compounds with the ability to reduce free radicals [25]. The results obtained correlate clearly with the total polyphenol content and strongly advocate for the consumption of these fruit and vegetables as potential natural additives in the food instead of synthetic compounds [14] [25] [38] [39].

4. Conclusion

Our study aimed at valorizing the African plants in general, and in particular some varieties of fruit and vegetables consumed in Congo Brazzaville. Twenty species of edible fruit and vegetables were analyzed in order to quantify their polyphenol and flavonoids content, and their antiradical activity. The contents of total polyphenols and flavonoids were higher in vegetable extracts than in fruit ones. However, fruit such as the *C. lacourtianum* and of *A. alboviolaceum* also showed high contents of total polyphenols and flavonoids. Among the vegetables studied, *C. pepo*, *I. batatas*, *H. sabdariffa* and *S. negrum* 1 had high levels of total polyphenols and flavonoids. In addition, extracts of *C. pepo*, *I. batatas*, *H. sabdariffa*, *S. negrum* 1, *F. capensis* and *A. alboviolaceum* also exhibited a substantial antiradical activity, justified by their considerable content in total polyphenols and flavonoids. Thus, these fruit and vegetables could not only be used to treat various health disorders, but also contribute significantly to the prevention of degenerative diseases. It would be important to extend the investigations by identifying the different phenolic compounds from vegetables and fruit that have shown both high phenolic compound contents and an important antiradical activity.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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