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Determination of phenolic compounds and evaluation of the antioxidant properties of four plants from Burkina Faso

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Abstract

Daniella oliveri (Caesalpiniaceae), *Sclerocarya birrea* (Anacardiaceae), *Maranthes polyandra* (Chrysobalanaceae), *Ptelopsis suberosa* (Combretaceae) have long been regarded as the medicinal plants. This research work was designed to evaluate the polyphenolic content, and antioxidant activity of extracts and fractions of these four plants of Burkina Faso. The extraction of the bioactive compounds was carried out by hydroethanolic maceration followed by a liquid-liquid fractionation with solvents of increasing polarities. Total phenols and flavonoids were determined by the Folin-Ciocalteu reagent and aluminum trichloride spectrophotometer, respectively. The antioxidant activities of the samples were evaluated by various in vitro assays like total reducing power, DPPH scavenging and ABTS radical cation decolorization assays. The highest extraction yields were obtained with ethyl acetate and butanol fractions. Of these four plants, only the species *Ptelopsis suberosa* had the highest levels of phenolic compounds. The total phenol and total flavonoid contents were respectively 22.37 ± 0.21 mg EAG / 100 mg and 16.05 ± 0.13 mg EQ / 100 mg hydroethanolic extract, 21.31 ± 0.21 mg EAG / 100 mg and 11.82 ± 1.98 mg EQ / 100 mg ethyl acetate fraction and 18.07 ± 0.41 mg EAG / 100 mg and 11, 22 ± 1.31 mg EQ / 100 mg butanolic fraction. The low levels of phenolic compounds were obtained with the species *Maranthes polyandra*. The results of the antioxidant activities showed that the hydroethanolic extract of *Ptelopsis suberosa* and the fraction of ethyl acetate of *Maranthes polyandra* present the best antioxidant activities with respectively an IC_{50} of 0.36 ± 0.19 and 0.47 ± 0.12 µg/mL and an inhibitory power of the radical ABTS of 32.28 ± 0.68 and 34.81 mg /g. The present study demonstrated that these four plants are an important source of phenolic compounds and have interesting antioxidant properties.

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Introduction

The use of plants by man merges with the very history of humanity for multiple purposes: cosmetic, food and pharmacological (Agbangnan, 2011). Thousands of scientific works have shown the presence of bioactive compounds of medicinal plants. These bioactive compounds have many therapeutic possibilities compared to chemotherapy which becomes more complicated and does not always bring the expected results. These works make it possible to offer more safety in the use of plants and they open new perspectives in the prevention and treatment of many pathologies. Unlike synthetic drugs, the medicinal plant not only provides an active ingredient but a multitude of compounds with complementary therapeutic effects, forming a balanced biochemical complex, the totum. Its softer and deeper action balances the body by stimulating natural defenses (Autran, 2010).

Polyphenols are quantitatively the most important secondary metabolites of plants. They have a wide variety of structures ranging from compounds containing a single phenolic nucleus (phenolic acid) to complex polymeric compounds such as tannins (catechin polymers and epicatechin having several tens of units). Polyphenols have the ability to modulate the activity of a large number of enzymes and some cell receptors. In addition, "*in vitro*", a large number of polyphenols are recognized for their antioxidant, anti-inflammatory, antifungal, antiviral and anticancer properties (Hamza *et al.,* 2006).

Polyphenols are the most common antioxidants in our diet. Several studies have been conducted on the impact of plant consumption on health. Most of these studies have shown a decline in the risk factor for many conditions such as myocardial infarction, lung cancer, colon cancer, stomach cancer, kidney cancer, prostate cancer, and breast cancer. Indeed, oxidation is a widespread phenomenon both in the food field (lipid oxidation) and physiological (oxidative stress). The ingestion of polyphenols through fruits and vegetables could allow our body to strengthen its defense against the oxidative processes that threaten our cells daily (Khan, 2010). Polyphenols, because of their antioxidant properties, have the capacity to trap free radicals, which are constantly generated by our body or formed in response to attacks from our environment (tobacco, pollutants, infections ...).

In Burkina Faso, according to the Ministry of Health, two thousand species of medicinal plants were already identified in 2004. Among these plants are: *Daniella oliveri* (Caesalpiniaceae), *Sclerocarya birrea* (Anacardiaceae), *Ptelopsis suberosa* (Chrysobalanaceae) and *Maranthes polyandra* (Combretaceae) that are widespread in many areas. These are planting whose leaves and barks are traditionally used in the treatment of several diseases such as malaria, cough, chronic ulcers, sexual infections, diarrhea, dysentery and many other purposes (Ouôba *et al.,* 2006).Previous phytochemical analyzes performed on *Daniella oliveri, Sclerocarya birrea, Ptelopsis suberosa* and *Maranthes polyandra* have shown the presence of a number of secondary metabolites, namely: saponosides, tannins, triterpene and flavonoids (Nacoulma, 1996 ; Iwueke *et al.,* 2008 ; Mundi *et al.,* 2012).

Apart from the identification of these secondary metabolites, only few information exists on the polyphenolic composition and the ability to trap free radicals by the extracts of these plants. Therefore, this study aimed at evaluating the polyphenolic content and antioxidant activity of these four plants.

Materials and methods

Chemicals and reagents

The Folin-ciocalteu reagent, sodium carbonate, aluminium trichloride, gallic acid and quercetin were purchased from Sigma-aldrich chemie, Steinheim, Germany. 2, 2-diphenylpicrylhydrazyl (DPPH), trichloroacetic acid, and solvents used were from Fluka Chemie, Switzerland. Ascorbic acid was from Labosi, Paris, France.

Plant materials

The different barks of the *Daniella oliveri,*

Sclerocarya birrea, Maranthes polyandra and Ptelopsis suberosa plants were harvested in the region of the upper basins (village of Nasso) in the month of February 2016. The plants were identified by the laboratory of Biology and Vegetal Ecology (UFR / ST, University of Nazi BONI). The different parts of the bark were dried at room temperature, away from the sun. They are then reduced to powder, kept in freezer bags for different extractions.

Maceration

The previously dried bark of the trunk was then reduced to fine particles by grinding with an electric grinder (tecator cyclotec 1093 sample mill). The powders thus obtained were used to carry out a cold ethanol maceration according to the method described by Zirihi *et al.* (2003).

For each plant, 50 g of bark powder was introduced into a 500 ml flask containing a mixture of ethanol and distilled water (70:30). The whole was subjected to magnetic stirring for 48 hours. At the end of these 48 hours, the mixture was filtered (filter paper schleicher and schuell 240 MM) and the filtrate obtained concentrated by rotary evaporation (Buchi Rotavapor R-200, Switzerland). Part of the aqueous solution was oven dried at 50°C until complete evaporation of the water and the other fractionated with immiscible organic solvents of increasing polarity.

Separations of extracts by liquid-liquid separation

For fractionation, the aqueous phases of the four plants are subjected to a series of liquid-liquid partitioning with immiscible organic solvents of increasing polarity: 50 ml of the hydroethanol macerates are extracted with 2 x 50 ml of n-hexane (n-H). The n-H solutions are combined and then concentrated under reduced pressure. The concentrates obtained are dried and the residues thus obtained constitute the hexanic fractions (FH). The aqueous phases which have been exhausted with hexane are again extracted as above but with 2 × 50 ml of ethyl acetate as the solvent. The solutions are pooled, concentrated and dried to give the ethyl acetate fractions (FAE). The aqueous phases resulting from the two previous treatments are extracted with n-butanol (2 x 50 ml). The n-butanol solutions are combined and allowed to evaporate at room temperature to give the butanol fractions (FB). At the end of all these operations, three fractions were obtained for each plant: hexane fraction (FH), ethyl acetate fraction (AcOEt) and butanolic fraction (Bu). The fraction residues were packed in waterproof plastic flasks and stored at 4°C until use. The yields of different crude extract and fraction were calculated and expressed as grams of extract residues/100 g of dried plant materials.

Total phenols

The estimation of the total extractable phenolic compounds content was carried out by the Folin-Ciocalteu method of Singleton (1999). It is based on the high oxidability of phenolic compounds. The reagent (Folin-Ciocalteu) used is a mixture of phosphomolybdate and sodium tungstate, which is reduced during the oxidation of phenols in an alkaline medium to a mixture of tungsten blue and molybdenum (Ribereau, 1968). The color produced (with a maximum absorption at 760 nm) is proportional to the amount of polyphenols present in the plant extracts to be assayed.

The extracts or fractions are dissolved in pure methanol to have a concentration of 10 mg / ml and then diluted to 1/100 in distilled water. A volume of 0.5 ml of the diluted solution was then mixed with 2.5 mL of 0.2 N Folin-Ciocalteu reagent and incubated for 5 min. 2 mL of a solution of sodium carbonate at 75 g / L in distilled water is then added and the mixture incubated for 2 hours. At the end of the incubation, the optical densities are read at 760 nm using a CECIL 2041 Series spectrophotometer. Total phenol levels are determined using a standard curve with gallic acid (0-200 mg /L) as a standard. In total, 3 readings are made for each extract and fraction and the result given is an average from these analyzes. The results are expressed in mg Equivalent Gallic Acid per 100 mg of extract or fraction (mg EAG/100 mg extract or fraction).

Total flavonoïds

The method used for the estimation of flavonoid levels in extracts and fractions of plants was described by Dowd adapted by Arvouet-Grand *et al.* (1994). The yellowish coloration given in this method is due to the formation of a complex between the aluminum chloride and the oxygen atoms present on the carbons 4 and 5 of the flavonoids (Lagnika, 2005). A volume of 5 ml of 2% $AlCl_3$ in pure methanol is mixed with an equal volume of 1 mg / ml extract or fraction in methanol. The optical densities are read after 10 min at 415 nm using a CECIL 2041 Series spectrophotometer. Quercetin (0-100 mg / l) was used as a standard for the development of the calibration curve. A mixture of 5 mL of extract or fraction and 5 mL of methanol without $AlCl_3$ served as a blank. Three readings are performed per sample of extract and fraction and the results are expressed in mg Equivalent Quercetin (EQ) per 100 mg of extract or fraction (mg EQ /100 mg).

Antioxidant activity

Two tests were used to evaluate the in vitro antioxidant capacity of the crude hydroethanol extracts and fractions of the four species studied in this work, it is the scavenging power of the cation radical ABTS $^{\bullet +}$ and the scavenging power of the radical DPPH $^{\bullet +}$. This step is intended to detect hydroethanol extracts and plant fractions with high antioxidant activity.

DPPH

It is the measure of antioxidant activity that evaluates the ability to reduce a stable free radical. The spectrophotometric method for 2,2-diphenyl-1-picrylhydrazyl (DPPH) described by Velazquez *et al.* (2003) is used. The 1,1-diphenyl-2-picrylhydrazyl molecule (DPPH) is a stable free radical, the solution of which has a violet coloration and a characteristic absorption at 517 nm. When a DPPH solution is mixed with an antioxidant hydrogen donor substance, there is formation of the reduced form. This causes the loss of purple coloration in yellow color characterized by a band of absorption in the visible at 517 nm (Brand-Williams, 1995).

We can summarize the reaction in the form of the equation:

Where: (AH) represents a compound capable of yielding a hydrogen to the DPPH (violet) radical for conversion to diphenyl picryl hydrazine (yellow) (Brand-William *et al.*, 1995).

A methanolic solution of DPPH at 20 mg /L is prepared. After a series of dilutions of the stock solution, a triplate is prepared for each concentration of the extract or fraction under consideration. 0.75 mL of each extract or fraction and 1.5 mL of DPPH were added to each tube. After an incubation of 15 minutes, the absorbances are read at 517 nm and the methanol is used as a blank sample. The antioxidant activity is expressed as a percentage inhibition according to the following formula:

% inhibition = (White Absorbance - Sample Absorbance) / White Absorbance × 100%

Three readings are carried out by extract or fraction and the average of the IC_{50} (concentration causing 50% inhibition of the DPPH radical) determined graphically, is calculated.

ABTS

The method described by Re *et al.* (1999) was used. It is based on the decolorization of a stable radical cation, ABTS $^{\bullet +}$ (2, 2'-azinobis- [3-ethylenzothiazoline-6-sulfonic acid]) in ABTS in the presence of antioxidant compounds at 734 nm. The radical cation ABTS $^{\bullet +}$ was regenerated by mixing an aqueous solution of ABTS (7 mM) with 2.5 mM potassium persulfate (final concentration) and the mixture is kept in the dark at room temperature for 12 hours before use. The mixture was then diluted with ethanol to give an absorbance of 0.70 ± 0.02 at 734 nm using the spectrophotometer. For each extract or fraction, a methanolic solution (10 mg / mL) is diluted 100th in ethanol. Thus 10 µL of sample (diluted solution), of the reference substance

(quercetin) were mixed with 990 µL of the fresh solution of ABTS $^{\bullet+}$. The whole is protected from light for 15 minutes and the absorbances were read at 734 nm spectrophotometer against a standard curve of trolox. The concentration of compounds having a reducing effect on the radical cation ABTS $^{\bullet+}$ is expressed in mg Trolox equivalent (mgET/g).

Statistical analysis

For statistical analysis, Microsoft Excel was used to obtain standard curves and graphs. ANOVA, were used to perform multiple comparison tests at $p<0.05$ significance level.

Results and discussion

Extractions yields

The hydroethanol extraction and fractionation by liquid-liquid separation of the phenolic compounds of the different plants allowed us to determine the yields of the crude extracts as well as the different fractions. The results are expressed as a percentage of dry matter.

Table 1. Yields of extractions and splits.

Plants	Extractions	yields (%)
Danielle oliveri	Hydroéthanolicextract	28,62 ± 0,94
	Ethyl acetate fraction	14,84 ± 0,54
	butanolic Fraction	5,8 ± 0,4
Sclérocarya birrea	Hydroéthanolicextract	21,02 ± 0,21
	Ethyl acetate fraction	7,48 ± 0,41
	butanolic Fraction	8,64 ± 0,5
Maranthes polyandra	Hydroéthanolicextract	14,4 ± 0,41
	Ethyl acetate fraction	0,44 ± 0,1
	butanolic Fraction	2,24 ± 0,16
Pteléopsis suberosa	Hydroéthanolicextract	14,28 ± 1,05
	Ethyl acetate fraction	0,88 ± 0,24
	butanolic Fraction	9,84 ± 0,64

Results indicated by different letters are statistically distinct ($p < 0.0001$).

The results obtained for the crude hydroethanol extracts, show that the highest yield is that of the hydroethanolic extract of the species *Daniella oliveri* (28.62 ± 0.94%) followed by the species *Sclerocarya birrea* (21.02 ± 0.94%) followed by *Maranthes polyandra* (14.4 ± 0.41%) and the lowest value in the species *Ptelopsis suberosa* (14.28 ± 1.05%) (Table 1). For the liquid-liquid partition made from the hydroethanol extract, the highest yields are observed at the level of the fractions by the medium polar solvents (fraction of ethyl acetate) to polar (butanolic fraction).

Determination of polyphenolic compounds

The hydroethanol extracts and the fractions (ethyl acetate and butanol) were used to determine the phenolic compounds.

Total phenol

The total phenol levels of the extracts and fractions of the species were determined from a regression curve obtained from a gallic acid solution which gave the following equation: $y = 9.5876x + 0.0067$; $R^2 = 0.9956$. These results show that the total phenol contents vary from 13.27 ± 0.2 (*Daniella oliveri* ethyl acetate fraction) to 22.37 ± 0.21 mg EAG / 100 mg (hydroethanolic extract of *Ptelopsis suberosa*) (Table 2). The high levels of total phenols were obtained with the hydroethanolic extract of *Ptelopsis suberosa*, followed by the ethyl acetate and butanol fraction of the same plant. The species *Ptelopsis suberosa* thus contains interesting total phenol levels compared to other species. Of the two solvents used for the liquid-liquid fractionation of the hydroethanol extracts of the four species, the ethyl acetate fractions showed

high levels compared to the butanol fractions. Ethyl acetate is therefore the organic solvent favorable to the extraction of total phenols. The fractionation of the crude extracts made it possible to group the compounds contained in our plants according to their polarity. This made it possible to present quantitative differences in flavonoids between the fractions of the same plant on the one hand and on the other hand between the fractions of the same nature of our four plants.

Table 2. Total phenol content of extracts and fractions.

Plants	Extractions	Total polyphenol contents (mg EAG / 100 mg extract or fraction)
Danielle oliveri	Hydroéthanolicextract	13,46±0,28^{hi}
	Ethyl acetate fraction	13,27±0,2^{d}
	butanolic Fraction	13,83±0,08^{ghi}
Sclérocarya birrea	Hydroéthanolicextract	15,16±0,42^{f}
	Ethyl acetate fraction	16,07±0,71^{e}
	butanolic Fraction	14,11±0,27^{gh}
Maranthes polyandra	Hydroéthanolicextract	14,18±0,3^{g}
	Ethyl acetate fraction	17,83±0,34^{d}
	butanolic Fraction	13,81±0,39^{ghi}
Pteléopsis suberosa	Hydroéthanolicextract	22,37±0,21^{a}
	Ethyl acetate fraction	21,31±0,89^{b}
	butanolic Fraction	18,07±0,41^{c}

Results indicated by different letters are statistically distinct ($p < 0.0001$).

Total flavonoids

The total flavonoid contents of the plants were determined against a standard curve (y = 0.0249x, R2 = 0.9943) of quercetin. These results indicate that the flavonoid contents of the extracts and fractions of these four species vary from 0.83 ± 0.50 mg EQ / 100 mg (hydroethanol extract of *Maranthes Polyandra*) to 16.05 ± 0.13 mg EQ / 100 mg (extract hydroethanolic acid of *Ptelopsis Suberosa*) (Table 3). The highest levels were obtained with the species *Ptelopsis suberosa*.

From these results, we can say that the total phenol content of *Daniella olivera* (hydroethanolic extract) is much higher than that obtained by Koudoro *et al.* (2015) in Benin, unlike flavonoids, which were respectively 0.39 ± 0.24 mg EAG / 100 mg and 7.9 ± 1.28 mg EQ / 100 mg extract. Cyanidine was used as a reference substance for the determination of flavonoids instead of quercetin; which could explain this difference.

These disparities in the content of phenolic

Compounds can also be explained by various factors such as the nature of the soil, the microclimate and also the period of harvest because these factors are of paramount importance in plant biosynthesis (Millogo, 2008). The phenolic content of a plant depends on a number of intrinsic and extrinsic factors (Falleh *et al.,* 2008). In addition, the hydroethanol extracts record the levels of high total polyphenols (22.37 ± 0.21 mg EAG / 100mg hydroethanolic extract of *Pteléopsis suberosa*). The work conducted by Mahmoudi *et al.* (2013) and by Koffi *et al.* (2010) confirm our results by indicating that ethanol in combination with water allows for better extraction of total polyphenols. Indeed, the addition of water to organic solvents increases the solubility of polyphenols (Sripad *et al.,* 1982**,** Mohammedi, 2011) by modulating the polarity of the organic solvent. This increase may be due to the weakening of the hydrogen bonds in the aqueous solutions. It could also be due to the increase in the basicity and ionization of polyphenols in such solutions (Sripad *et al.,* 1982)**.** The solubility of polyphenols depends mainly on the number of hydroxyl groups, molecular weight and the length of the basic backbone carbonic chain (Mohammedi, 2011).

Table 3. Flavonoid contents, extracts and fractions.

Plants	Extractions	Flavonoids content totals (mgEQ / 100 mg extract or fraction)
Danielle oliveri	Hydroéthanolicextract	2,32 ±0,38^{de}
	Ethyl acetate fraction	3,57±0,26^{cd}
	butanolic Fraction	4,19±0,96^{c}
Sclérocarya birrea	Hydroethanolicextract	3,12±0,52^{cd}
	Ethyl acetate fraction	2,33±0,31^{d}
	butanolic Fraction	4,16±0,71^{c}
Maranthes polyandra	Hydroethanolicextract	0,83 ± 0,50^{e}
	Ethyl acetate fraction	3,50±0,11^{cd}
	butanolic Fraction	2,88±0,34^{cd}
Pteléopsis suberosa	Hydroéthanolicextract	16,05±0,13^{a}
	Ethyl acetate fraction	11,82±1,98^{b}
	butanolic Fraction	11,22±1,31^{b}

Results indicated by different letters are statistically distinct (p <0.0001).

Activity anti-radical

In the body, various types of oxidation take place and lead to the accumulation of free radicals. Also, the diversity and specificity of antioxidants (radical scavengers, electron donors or hydrogen atoms) make it necessary to evaluate the antioxidant activity by various methods. Thus, two (02) methods (DPPH and ABTS) were used to evaluate the anti-radical activity of hydroethanol extracts and fractions of *Daniella oliveri, Sclerocarya birrea, Maranthes polyandra, Ptelopsis suberosa.*

Anti-radical activity

DPPH

The anti-radical activity (AAR) of plant extracts reflects their ability to reduce free radicals. The evaluations of the anti-radical properties of the extracts and fractions of the four species made it possible to calculate the DPPH reduction percentages by increasing concentrations of extracts.

Concentrations trapping 50% of free radicals (IC_{50}) were determined by the curves of the percentages of inhibitions as a function of the concentrations of extracts.

We obtain curves having an exponential appearance with the presence of a stationary phase which signifies the almost total reduction of the DPPH in its non-radical form. The smaller the IC_{50} value, the more the extract has a strong antioxidant activity. The different IC_{50} obtained are shown in Table 4.

Table 4. DPPH radical hard inhibitor power of extracts, fractions and standards.

Plants	Extracts/ fractions	IC_{50} (µg/ml)
Daniella oliveri	Hydroéthanolicextract	0,51±0,08^{def}
	Ethyl acetate fraction	0,71±0,2^{bcdef}
	butanolic Fraction	0,63±0,04^{bcdef}
Sclerocarya Birrea	Hydroethanolicextract	0,87±0,14^{abcd}
	Ethyl acetate fraction	0,59±0,06^{cdef}
	butanolic Fraction	0,73±0,20^{bcdef}
Maranthes Polyandra	Hydroethanolicextract	1,08±0,15^{ab}
	Ethyl acetate fraction	0,47±0,12^{ef}
	butanolic Fraction	0,81±0,03^{bcde}
Ptelopsis Suberosa	Hydroethanolicextract	0,36±0,19^{f}
	Ethyl acetate fraction	0,96±0,14^{abc}
	butanolic Fraction	0,53±0,23^{def}
Standards	Quercétin	0,93±0,02
	Gallic acid	0,60±0,01

The results presented by the different letters are significantly different at P <0.0001.

The results expressed in IC $_{50}$ of the anti-radical activity (Table 4) reveal that all the extracts and fractions tested as well as the standard compounds exhibit an antioxidant activity. The hydroethanol macerate of *Ptelopsis suberosa* exhibited the highest anti-radical activity (0.36 ± 0.19 µg / ml) followed by the fraction of ethyl acetate of *Maranthes polyandra* (0.47 ± 0.12). µg / ml) and lastly the hydroethanolic extract of *Maranthes Polyandra* (1.08 ± 0.15 µg /mL).Most of the anti-radical activities of the extracts and fractions are more pronounced than those of quercetin and gallic acid, which are synthetic compounds used as references in this study. These results are similar to those of Koudoro *et al.* (2015), who found that the trunk bark of *Daniella olivera* had good antioxidant activity.

Radical cation reduction ABTS $^{\bullet+}$

Anti-radical activity using the ABTS method as described by Re *et al.* (1999) was used to determine the antioxidant potency of hydroethanol macerates and the fractions of *Daniella olivera*, *Sclerocarya birrea, Maranthes polyandra, Ptelopsis suberosa.*

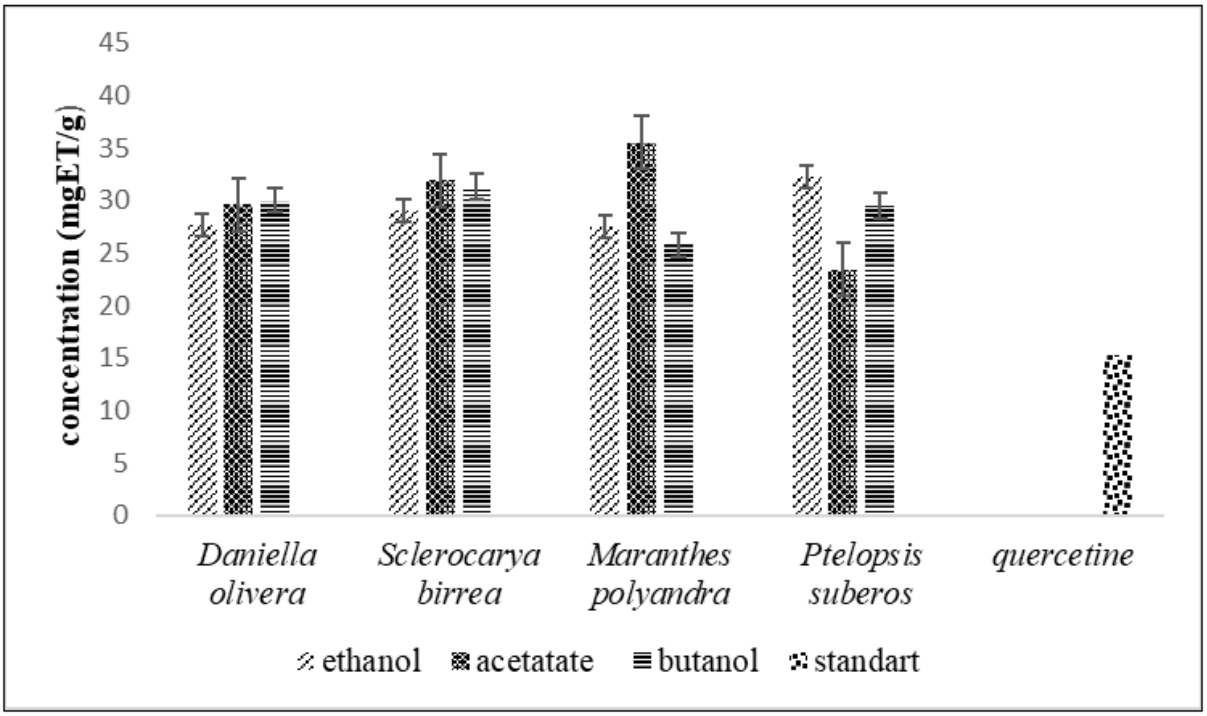

Fig. 1. Inhibitory potency of the ABTS radical of the extracts, fractions and reference compound.

In our study, concentrations were determined against a trolox reference curve whose regression equation is as follows: y = -0.0016x + 0.6546; R2 = 0.9903. The values of the antioxidant capacity obtained ranged from 28.75 ± 1.02 (hydroethanolic macerate) to 30.17 ± 0.47 mg ET /g (butanolic fraction) for *Daniella oliveri*, from 29.04 ± 0.65 to 30.42 ± 0.65 mg ET /g (ethyl acetate fraction) for *Sclerocarea bierra*, from 25.57 ± 0.97 (macerated hydroethanol) to 34.81 ± 0.68 mg ET/g (ethyl acetate fraction) for *Maranthes polyandra* and finally from 22.71 ± 0.54 (ethyl acetate fraction) to 32.28 ± 0.68 mg ET/g (hydroethanolic macerate) for *Ptelopsis suberosa* (Figure 1). The anti-radical activity ABTS$^{\bullet+}$ obtained in this study shows that our plants are rich in compounds capables of yielding electrons or hydrogens. It is mainly the fractions (ethyl acetate and butanol) which have the best antiradical powers compared to the mother extracts (hydroethanol). These anti-free radical powers are superior to that of quercetin which is a pure compound (15.32 ± 0.25 mg ET/g) used here as a reference. In view of these results, the barks of *Daniella olivera*, *Sclerocarya birrea, Maranthes polyandra*, *Ptelopsis suberosa* could be exploited for the preservation of human health through their antioxidant activity. Indeed, the

cellular and oxidative lesions linked to free radicals or to ROS appear today as one of the main causes of several human diseases involving hypertension, cancer, arteriosclerosis, rheumatism, Alzheimer's disease, heart disease, autoimmune diseases, disorders of the digestive system such as peptic ulcer, intestinal and intestinal inflammations, neurodegenerative disorders, diabetes and viral infections (Bonnefoy *et al.*, 2002; Huang *et al.* 2005; Li *et al.*, 2009). These free radicals, which naturally occur in the normal metabolism of living organisms, can be captured through chemo-prevention using the antioxidant compounds found in human nutrition and medicinal plants (Kubola *et al.,* 2008; Verma *et al.*, 2009).

Conclusion

In the present work, different aspects of *Daniella oliveri, Sclerocarya birrea, polyandra Maranthes, Ptelopsis suberosa* were studied: a quantitative study of phenolic compounds and the antioxidant activity of crude extracts and fractions.Extraction and fractionation of the bark of plants yielded different yields depending on the solvents used. Quantification of phenolic compounds, to know total phenolics and total flavonoids, made it possible to note that the hydroethanolic extract and the ethyl and butanolic acetate fractions of *Ptelopsis Suberosa* had the highest levels of total phenolics and flavonoids. The study of the antioxidant activity of the extracts and fractions of the four plants showedthat all the extracts and fractions have an interesting antioxidant power, in this case the hydroethanol macerate of *Ptelopsis suberosa* and the fraction of ethyl acetate of *Maranthes polyandra* which respectively gave the best antioxidant potentials (DPPH and ABTS).

Conflict of interest statement

We declare that we have no conflict of interest.

References

Agbangnan DCP. 2011. Extraction et concentration d'extraits polyphénoliques naturels, bioactifs et fonctionnels par procédés membranaires: Caractérisation des structures moléculaires d'extraits du sorgho rouge (*sorghum caudatum*) du Bénin. Thèse de doctorat, Faculté des Sciences et Techniques, Université d'Abomey-Calavi, Bénin, p 355

Arvouet-Grand A, Vennat B, Pourrat A, Legret P. 1994. Standardisation d'un extrait de propolis et identification des principaux constituants. Journal de Pharmacie de Belgique **49(6),** 462-468.

Autran JC. 2010. Le guide de phytothérapie créole : Se soigner par les plantes créoles. Ile Reunion, édition Orphie, p 371.

Bonnefoy M, Drai J, Kostka T. 2002. Les antioxydants pour retarder les effets du vieillissement, faits et perspectives: Peut-on prévenir le vieillissement ? Presse Medical **31(24)**, 1174-1184.

Brand-Williams W, Cuvelier ME, Berset C. 1995. Use of à Free Radical Method to Evaluate Antioxidant Activity. Food Science and Technology-Lebensmittel-Wissenschaft & Technologie **28(1)**, 25-30.
https://doi.org/10.1016/S0023-6438(95)80008-5

Falleh H, Ksouri R, Chaieb K, Karray-Bouraoui N, Trabelsi N, Boulaaba M, Abdelly C. 2008. Phenolic composition of *Cynara cardunculus* L. organs, and their biological activities. C R Biologies **331**, 372-379.

Hamza OJM, Van den Bout-van den Beukel Carolien JP, Matee Mecky IN, Moshi Mainen J, Mikx Frans HM, Selemani Haji O, Mbwambo Zakaria H, Van der Ven André JAM, Verweij Paul E. 2006. Antifungal activity of some Tanzanian plants used traditionally for the treatment of fungal infections. Journal of Ethnopharmacology **108**, 124-132.
https://doi.org/10.1016/j.jep.2006.04.026

Huang D, Ou B, Prior B. 2005. The chemistry behind antioxidant capacity assays. Journal of Agricultural and Food Chemistry **53(6)**, 1841-

1856. https://doi.org/10.1021/jf030723c

Iwueke AV, Nwodo OFC. 2008. Antihyperglycaemic effect of aqueous extract of *Daniella oliveri* and *Sarcocephalus latifolius* roots on key carbohydrate metabolic enzymes and glycogen in experimental diabetes. Biokemistri. **20**, 63–70.

Khan MK. 2010. Polyphénols d'Agrumes (flavanones): extraction de glycosides de la peau d'orange, synthèse de métabolites chez l'homme (glucuronides) et étude physico-chimique de leur interaction avec le sérum albumine. Thèse de doctorat, Université d'Avignon et des Pays de Vaucluse, p 169.

Koffi E, Sea T, Dodehe Y, Soro S. 2010. Effect of solvent type on extraction of polyphenols from twenty-three Ivorian plants. J. Animal & Plant Sci. **5(3),** 550-558.

Koudoro YA, Wotto DV, Konfo TRC, Agbangnan DCP, Sohounhloue CKD. 2015. Phytochemical screening, antibacterial and anti-radical activities of *Daniellia oliveri* trunk bark extracts used in veterinary médicine against gastrointestinal diseases in Benin. International Journal of Advanced Research **3(10),** 1190-1198.

Kubola J, Siriamornpun S. 2008. Phenolic contents and antioxidant activities of bitter gourd (*Momordica charantia* L.) leaf, stem and fruit fraction extracts in vitro. Food Chemistry **110(4),** 881-890.

Lagnika L. 2005. Etude phytochimique et activité biologique de substances naturelles isolées de plantes béninoises. Thèse de doctorat, Université Louis Pasteur Strasbourg, p 249.

Li HY, Hao ZB, Wanga XL, Lei Huang L, Li JP. 2009. Antioxidant activities of extracts and fractions from *Lysimachia foenum*-graecum Hance. Bioresource Technology **100(2)**, 970-974. https://doi.org/10.1016/j.biortech.2008.07.021

Mahmoudi S, Khali M, Mahmoudi N. 2013. Etude de l'extraction des composés phénoliques de différentes parties de la fleur d'artichaut (*Cynara scolymus* L.). Revue « Nature & Technologie ». B-Sciences Agronomiques et Biologiques **09**, 35-40.

Millogo H. 2008. Etude des paramètres phytochimiques et des activités biologiques de *Parkia biglobosa* (Jacq) Benth (Mimosaceae). Thèse de Doctorat d'Etat es Sciences Naturelles, Université de Ouagadougou, p 169.

Mohammedi Z, Atik F. 2011. Impact of solvent extraction type on total polyphenols content and biological activity from *Tamarix aphylla* (L.) karst. Inter J Pharma Bio Sci **2(1)**, 609-615.

Mundi AD, Umar AZ, Musa YM, Adamu RS, Bamayi LJ. 2012. Preliminary Phytochemical Determination of Some Botanical Bark Powders. Publication of Nasarawa State University Keffi **8(1)**, 91-104.

Nacoulma OG. 1996. Plantes médicinales et Pratiques médicales Traditionnelles au Burkina Faso: cas du plateau central/ Tome II. Thèse d'Etat en Biochimie, Université de Ouagadougou (Burkina Faso), p 328.

Ouôba P, Lykke AM, Boussim J, Guinko S. 2006. La flore médicinale de la Forêt Classée de Niangoloko (Burkina Faso). Etudes flor. vég. Burkina Faso **10,** 5-16.

Re R., Pellegrini N, Proteggente A, Pannala A, Yang M, Rice-Evans C. 1999. Antioxidant activity applying an improved ABTS radical cation decolorization assay. Free Radical Biology and Medicinal **26(9-10),** 1231-1237. https://doi.org/10.1016/s0891-5849(98)00315-3

Ribereau GP. 1968. Les composés phénoliques des végétaux. Dunod, Paris, 254 p.

Singleton VL, Orthofer R, Lamuela-Raventos RM. 1999. Analysis of phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalceu Reagent. Methods in Enzymology **299,** 152-178.

Sripad G, Prakash V, Narasinga RMS. 1982. Extractability of polyphenols of sunflower seed in various solvents. Journal of Bioscience **4,** 145-152.

Velazquez E, Tournier HA, Mordujovch de Buschhiazzo P, Saavedra G, Schinella GR. 2003. Antioxidant activity of Paraguayan plant extracts. Fitoterapia **74,** 91-97.

Verma B, Hucl P, Chibbar RN. 2009. Phenolic acid composition and antioxidant capacity of acid and alkali hydrolysed wheat bran fractions. Food Chemistry **116,** 947-954.

Zirihi G, Kra AKM, Guede-Guina F. 2003. Évaluation de l'activité antifongique de*Microglossa pyrifolia* (Lamarck) *O. Kantze* (Astéracée) «PYMI» sur la croissance in vitro de *Candida albicans*. Revue de Médecine et pharmacie Afrique **17,** 11- 18.