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Antioxidant and antifungal activities of *Myrianthus arboreus* P. Beauv. (Moraceae), *Allanblackia gabonensis* Pellegr. (Clusiaceae) and three other Cameroonian medicinal plants

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Abstract

Background: Biological activities of medicinal plants make them attractive alternative complementary medicines. Therefore, this study aimed to assess the antioxidant and antifungal activities of the methanol extract of *Myrianthus arboreus*, *Allanblackia gabonensis*, *Gladiolus quartinianus*, *Peperomia fernandopoiana* and *Vepris soyauxii*.

Methods: Total phenolic contents (TPC) and flavonoid contents (FC) were evaluated using standard methods. The antioxidant activity of the extracts was determined by 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical scavenging and ferric reducing power assays. Antifungal activity was evaluated by the broth micro-dilution method.

Results: TPC of extracts ranging from 67.89 to 196.01 mgGAE/g TPC were very higher in *P. fernandopoiana* whole plant (PFW) extract (196.01±10.25 mgGAE/g) and MAL (165.71±10.68 mgGAE/g) whereas the *A. gabonensis* fruit extract (AGF) and *M. arboreus* bark extract (MAB) had the highest flavonoid content (66.54 ± 2.12 and 48.13 ± 1.65 mgEC/g of extract, respectively). Apart from *M. arboreus* leave extract (MAL), all extracts showed important DPPH radical scavenging activity (IC_{50} < 20 µg/mL). AGFI and PFW exhibited significant ferric reducing power compared to ascorbic acid and other extracts (P<0.05). Each of the tested extracts showed antifungal activity against atleast one of the five pathogenic fungi, with MICs ranging from 128 to 1024 µg/mL. MAL was active on all the tested fungi whereas MAB showed the highest antifungal activity (MIC=128 µg/mL).

Conclusion: The findings of this study emphasize the evidence that the methanol extracts of the leave and bark of *Myrianthus arboreus* could be an alternative to fight against oxidative stresses and infections due to opportunistic yeast pathogens.

Keywords: Oxidative stress; fungal infection; medicinal plant; antioxidant activity; antifungal activity.

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Background

The cells of living organisms generate free radicals because of physiopathological and biochemical processes in response to factors such as environmental pollutants, radiation, chemicals, toxins as well as infections. Reactive oxygen species (ROS) are highly toxic as they can inflict injuries to tissues through oxidative damage to lipids, nucleic acids, and proteins [1]. This can lead to chronic diseases such as Alzheimer's disease, atherosclerosis, diabetes and even cancers [2]. Although an endogenous system of antioxidant is present in our body to get rid of excessive free radicals, exogenous antioxidants are recommended [3]. Antioxidants can be natural and synthetic, but due to toxic and carcinogenic effects, synthetic antioxidants, such as butylhydroxyanisole and butylhydroxytoluene are being replaced with natural antioxidants [4]. Infectious diseases are one of the major problems of the world. Every year, about 15 million (>25%) of the 57 million deaths worldwide are caused by infectious diseases [5]. Nowadays, fungal infections are being increasingly recognized as important public health problems owing to an ever-expanding population of immuno-compromised patients [6]. They are usually associated with *Candida*, *Aspergillus* and *Cryptococcus* species. But those due to *Candida* species represent the main opportunistic fungal infections worldwide, leading to high morbidity and mortality in the population [7]. Among the existing antifungal drugs, only few classes are currently effective against fungal infections because the toxic effects, and the emergence of drug resistance have limited the use of many of these drugs [8]. Therefore, the discovery of new antioxydant and/or antifungal agents is still relevant. That is why scientists are looking for more effective and less toxic substances from natural sources such as medicinal plants.

Medicinal plants have been used to treat human diseases for thousands of years because they have vast and diverse metabolites with a wide range of biological activity including the antimicrobial, antioxidant, and anti-inflammatory activities [9]. Such compounds could be used for the development of new drugs to inhibit growth of fungal pathogens and to quench ROS with possibly novel mechanisms of action and low toxicity [10]. It is demontrated that plant-derived natural antioxidants can play a vital role to protect from microbial infections [11]. The naturally occurring antioxidant chemicals have been reported to be composed of phenolic (such as flavonoids, phenolic acids, and tocopherols) and nitrogen compounds (alkaloids, amino acids, etc.) as well as carotenoids and ascorbic acid [12]. Also, phenolic acids and flavonoids have been proposed as potential natural fungicides to control fungal phytopathogens [13]. Previous works have demonstrated that some Cameroonian medicinal plants possessed antimicrobial and/or antioxidant properties [14-17].

This study aimed to assess the antioxidant and antifungal activities of the methanol extracts of *Myrianthus arboreus* P. Beauv. (Moraceae), *Allanblackia gabonensis* Pellegr. (Clusiaceae), *Gladiolus quartinianus* A. Rich (Iridaceae), *Peperomia fernandopoiana* C.D.C. (Piperaceae) and *Vepris soyauxii* Engl. (Rutaceae). These plants are curently used in Africa to treat many ailments including infectious diseases and inflammatory conditions. Also, previous studies have demeonstrated that some of these plants contained bioactive compounds like phenols which are potential antioxidants/or antimicrobial substances (Table 1).

Methods

Plant materials

The plants used in this work were the leave, fruits and bark of *Myrianthus arboreus,* flowers and fruits of *Allanblackia gabonensis*, the leave of *Vepris soyauxii,* the whole plants of *Gladiolus quartinianus* and *Peperomia fernandopoiana*. They were collected between January and April 2012 in the West, South-west, and Littoral regions of Cameroon. All the plant samples harvested were identified at the National herbarium (Yaounde, Cameroon), where voucher specimens were deposited under the reference numbers (Table 1).

Preparation of plant extracts

Each plant sample was air-dried at room temperature (25± 2°C), powdered by grinding and a portion of each sample (200 g) was extracted with methanol (MeOH; 0.6 L) for 48h at room temperature. After filtration using Whatman No.1 paper, the filtrate was concentrated under reduced pressure at 45°C using a rotary evaporator (Buchi R-200) to give residues, which constituted the extract. All extracts were then kept at 4°C until further use.

Evaluation of total phenolic contents

The quantitative determination of total phenolic content of plant extracts was carried out using the Folin–Ciocalteu method [38]. Briefly, 0.02 ml of extract (2 mg/mL), 1.38 mL of distilled water and 0.02 mL Folin reagent were mixed and the mixture was allowed to stand at room temperature for 5 min. Then, 0.4 mL of 20% (w/v) sodium carbonate was added to the mixture and mixed gently. The mixture was later incubated in water bath at 40°C for 20 min and the absorbance of the mixture was measured at 760 nm against a blank tube prepared with distilled water instead of plant extracts. Each test was performed in triplicate and the results were expressed as milligrams of Equivalents Gallic Acid per gram of extract (mgEGA/g) using a standard calibration curve of gallic acid (R^2 = 0.99).

Evaluation of total flavonoids contents

The flavonoid content was determined according to the method described by Atsafack *et al.* [15]. Briefly, 0.1 mL of extract (2 mg/mL) were mixed with 1.49 mL of distilled water and 0.03 mL of 5% sodium nitrite (w/v). The mixture was manually shaken and incubated for 5 min at 40°C. Then, 0.03 mL of 10% aluminum chloride (w/v) was added and the mixture was reincubated for 3 min. Finally, 0.2 mL of sodium hydroxide (0.1 M) and 0.24 mL of distilled water were added, and the mixture was incubated for 30 min in the dark. The absorbance was recorded at 510 nm. Each test was performed in triplicate and the results were expressed as milligrams of Equivalents Catechin (mgECat) per gram of extract using a standard calibration curve of Catechin (R^2 = 0.98).

Antioxidant assay

2, 2-Diphenyl-picryl-hydrazyl (DPPH) radical scavenging assay

The free radical scavenging activity (RSA) of the extracts was evaluated using the DPPH assay method as described by Mensor *et al.* [39] with some modifications. Briefly, each sample was two-fold serially diluted with methanol. One hundred microliters of

diluted sample were mixed with 0.90 mL of 0.3 mM DPPH methanol solution to give a final sample concentration of 12.5, 25, 50, 100 and 200 µg/mL respectively. After 30 min of incubation in the dark at room temperature, the optical density was measured at 517 nm. Each assay was done in triplicate. The DPPH radical-scavenging capacity (%) was calculated using the following equation: RSA (%) = $[1 - (A_1 - A_2) / A_0] \times 100$; where A_0 was the absorbance of the control (without sample), A_1 was the absorbance in the presence of the sample, and A_2 was the absorbance without DPPH. %RSA were converted into probits and plotted against the logarithmic of the concentrations, then a linear regression curve was established to calculate the sample concentration providing 50% inhibition (IC_{50}) defined as the quantity of sample which decreases by 50% the free radical DPPH. Tests were performed in triplicate. Ascorbic acid was used as positive control.

Determination of ferric reducing power

The ferric reduction potential of the extracts was determined according to the previously described method [40] with slight modification. Briefly, 0.2 mL of two-folds serial dilution of the extracts (200 to 12.5 µg/mL) was mixed with 0.5 mL of 0.2 M phosphate buffer solution (pH 6.6) and 0.5 mL 1% potassium ferricyanide ($K_3Fe(CN)_6$) solution. The mixture was incubated in a water bath at 50°C for 20 min; followed by the addition of 0.5 mL of 10% trichloroacetic acid. After 30 min, the tubes were centrifuged at 3000 rpm for 10 min. An aliquot of supernatant (0.5 mL) was mixed with 0.5 mL of distilled water and 0.1 mL of 0.1% methanolic $FeCl_3$ solution. The absorbance of the reaction mixture was read at 700 nm against a control containing distilled water instead of extract. Ascorbic acid was used as reference antioxidant. Any increased in absorbance of the reaction mixture indicates a higher ferric reduction power of the extracts.

Antifungal Assay

Fungal strains and culture conditions

The fungal strains used in this study were *Candida albicans* ATCC9002, *Candida parapsilosis* ATCC22019, *Candida tropicalis* ATCC750 (American Type Culture Collection), *Cryptococcus neoformans* P95026 (*Institut Pasteur, France*) and a clinical isolate namely *Candida guilliermondii* (*Centre Pasteur*, Yaoundé-Cameroon). Sabouraud dextrose agar (SDA) was used for the maintenance and culture of fungi while Sabouraud dextrose broth (SDB) was used for the determination of the minimum inhibitory concentrations (MICs) and minimum fungicidal concentrations (MFCs).

Determination of MIC and MFC

The minimal inhibitory concentrations (MICs) were determined by the micro-dilution method using INT colorimetric as previously described [41]. Briefly, extracts were first dissolved in DMSO/SDB (1:1 V/V) and serially diluted two-fold in SDB, making each well to 0.1 mL (in a 96-wells microplate). One hundred microliters (0.1 mL) of inoculum (2.4×10^4 CFU/mL) prepared in SDB were then added. Wells containing SDB, inoculum and DMSO at a final concentration of 2.5% served as negative control. Nystatin was used as reference antifungal drug. Each plate was then covered with a sterile plate sealer, gently shaked to mix the contents of the wells followed by incubation at 35°C. The MICs of samples were detected after 48h incubation at 37°C, following the addition of 0.04 mL of a 0.2 mg/mL INT solution and further incubation at 35°C for 30 minutes. Viable yeasts reduced the yellow INT dye to pink. MIC was defined as the lowest sample concentration that exhibited complete inhibition of microbial growth and hence prevented this color change. The MFCs were determined by adding 0.05 mL of the suspensions from the wells, which did not show any growth after incubation during MIC assays, to 0.15 mL of fresh broth. These suspensions were re-incubated at 35°C for 72h. The MFC was determined as the lowest concentration of sample which completely inhibited the growth of fungi. Each assay was performed in three independent tests.

Statistical analysis

The TPC, FC and the antioxidant results were expressed as mean ± Standard deviation. Statistical analysis of data was performed by one-way analysis of variance (ANOVA) and the levels of significance, considered at $P < 0.05$, were determined by Waller-Duncan test using Statistical Package for Social Sciences Software program version SPSS 21.0.

Results

Total phenolic content

The total phenolic content (TPC) of extracts was determined using Folin-Ciocateu Reagent. The results depicted in Table 2 showed that the TPC, expressed as gallic acid Equivalents (GAE)/g of dry extract, varied to a great extent, and ranged from 67.89 to 196.01 mgGAE/g and was significantly different ($p < 0.05$) from one plant extract to the other (Table 2). TPC was higher in *P. fernandopoiana* whole plant extract (PFW) (196.01±10.25 mg GAE/g) followed by *M. arboreus* leave extract (MAL) (165.71±10.68 mgGAE/g) and MAB (158.79±3.60 mgGAE/g) compared to other extracts.

Total flavonoids content

The total flavonoid content (TFC) ranged from 21.15 to 66.54 mgCE/g of dry extract. It was significantly different ($p < 0.05$) from one plant extract to the other (Table 2). *A. gabonensis* fruit extract (AGF) and *M. arboreus* bark extract (MAB) had the highest flavonoids content (66.54 ± 2.12 and 48.13 ± 1.65 mgEC/g of extract, respectively); followed by *A. gabonensis* flower extract (AGFl) and *M. arboreus* leave extract (MAL) compared to the rest of the extracts ($p < 0.05$).

DPPH radical scavenging activity

The DPPH radical scavenging activity (RSA) of the various samples increased in a concentration-dependent manner (Table 3). It appears that the RSA was generally important at all the tested concentrations of different plant extracts except those of *V. soyauxii* leave extract (VSL) and MAF at 12.5 - 25 µg/mL. At the higher extract concentration (200 µg/mL), it was ranging from 91.04 to 96.60%. Apart from *M. arboreus* fruit extract (MAF), all the extracts showed IC_{50} values less than 20 µg/mL. It was also found that the activity of AGFl, AGF, MAB and MAL ($0.03 \leq IC_{50} \leq 0.41$ µg/mL) was greater than that of ascorbic acid (IC_{50}: 0.42 µg/mL).

Ferric reducing power activity

The results of the Ferric reducing antioxidant power of the extracts are presented in Figure 1. It appears that the reducing power of

different plant extracts increased in a concentration-dependent manner and varies from one extract to another. AGFl and PFW exhibited significant ferric reducing power compared to ascorbic acid, AGF, VSL and *G. quartinianus* whole plant extract (GQW) ($p < 0.05$). However, the reducing power of AGFl and ascorbic acid are comparable at the highest concentration (200 µg/mL).

Antifungal activity

The antifungal activity of the crude methanol extracts from *A. gabonensis*, *G. quartinianus*, *P. fernandopoiana*, *V. soyauxii*, and *M. arboreus* have been evaluated trough the determination of MICs and MFCs against five pathogenic fungi. The results presented in Table 4 indicate that each of the tested extracts displayed antifungal activity on at least one of the 6 yeasts with MICs ranging from 128 to 1024 µg/mL. The MFCs were detected on few tested strains and were ranged from 512 to 1024 µg/mL. The leave extract of *M. arboreus* (MAL) was active on all the tested fungi. The highest antifungal activity was developed by bark extract of *M. arboreus* (MAB) as it presented the lowest MICs (128 µg/mL) against *C. tropicalis* ATCC750 and *C. albicans* ATCC9002 strains. Moreover, these pathogens were the most sensitive to the tested extracts.

Discussion

This study was aimed to assess the possible antioxidant and antifungal activities of the methanol extracts of *Myrianthus arboreus*, *Allanblackia gabonensis*, *Gladiolus quartinianus*, *Peperomia fernandopoiana* and *Vepris soyauxii*.

The antioxidant property of the extracts was evaluated using the DPPH free radical scavenging and ferric reducing antioxidant power (FRAP) assay. The DPPH free radical scavenging assay is based on the ability of the stable free radical 2,2-diphenyl-1-picrylhydrazyl to react with hydrogen donors including phenols [42]. According to Souri *et al.* [43], an extract is considered as having significant antioxidant potential when $IC_{50} < 20$ µg/mL, moderate when $20 \leq IC_{50} \leq 75$ µg/mL and weak when $IC_{50} > 75$ µg/mL. Based on that, all the plant extracts and ascorbic acid possessed a significant DPPH scavenging activity except the MAF, which displayed moderate activity (Table 3). Transition metals in their reduced state may participate in the Fenton reaction. It is the case of Fe^{2+}, which in its free state is a powerful electron donor, reacting notably with hydrogen peroxide to generate highly reactive hydroxyl radicals [44]. The ferric reducing capacity of a compound may serve as a significant indicator of its potential antioxidant activity [45]. Some compounds in plant extracts such as flavonoids are electron or hydrogen donors and can reduce the oxidized intermediates of lipid peroxidation processes by reacting with free radicals in other to convert them into more stable products and to terminate radical chain reactions. In this study, the reducing power of plant extracts increased with their concentration. These results are in correlation which those observed by Atsafack *et al.* [15] who showed plant extracts may prevent oxidative damage induced by ferric ions in a biological system. The antioxidant activity of polyphenol compounds is mainly attributed in their ability to scavenge free radicals, to inhibit lipid peroxidation, and to chelate transition metals [46]. The biological activities of flavonoids are linked in their ability to transfer electrons to free radicals, chelate metals, activate antioxidant enzymes and reduce radicals of alpha-tocopherol or inhibit oxidases [47]. Our previous studies have demonstrated that some of the tested plant samples as *A. gabonensis*, *G. quartinianus*, *P. fernandopoiana* and *V. soyauxii* containned phenolic compounds and flavonoids [27, 34]. This study showed that PFW and MAB had the highest phenolic compounds while AGF and MAB had the highest flavonoid contents (Table 2). So, the high DPPH radical-scavenging and ferric reducing power activities of tested plant extracts at different concentrations could be attributed to their content in both secondary metabolite groups.

The *in vitro* antifungal activity of the methanol extracts from *A. gabonensis*, *G. quartinianus*, *P. fernandopoiana*, *V. soyauxii*, and *M. arboreus* have been evaluated through the determination of MICs and MFCs against six yeast strains. The antimicrobial activity is significant if MIC values are below 100 µg/mL for crude extract and moderate when the MICs vary from 100 to 625 µg/mL [48]. All the extracts presented low to moderate antifungal activity across the tested fungal species ($128 \leq MIC \leq 1024$ µg/mL). The highest antifungal activity was developed by bark extract of *M. arboreus* (MIC=128 µg/mL) and can be correlated to their contain in phenolic componds or flavonoids as well as its antioxydant property. Therefore, no correlation was observed between the antifungal activity and the phenolic or flavonoid content of other plant samples. For the same plant extract, the sensitivity of the fungal strains varied considerably. These observed variations in antifungal activity of these extracts could be due to the differences in the chemical composition, the nature of the plant material, its origin and the part used [49]. Among the five pathogenic fungi, *C. albicans* was the most sensitive to the extracts. This is important since *C. albicans* is the most prevalent pathogen in systemic fungal infections [7, 50].

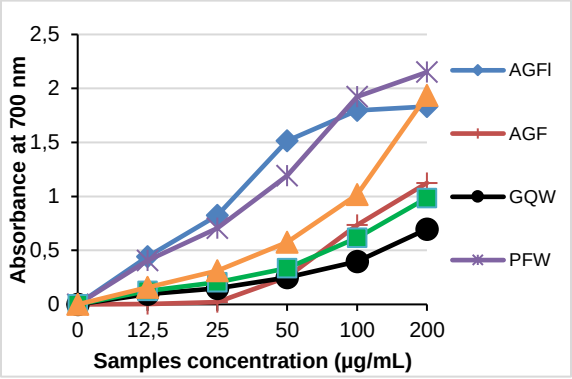

Figure 1. Ferric reducing power of the different plant extracts and ascorbic acid. **AGFl**: *A. gabonensis* flower extracts
***AGF**: A. gabonensis fruit extract; **GQW**: G. quartinianus whole plant extract; **PFW**: P. fernandopoiana whole plant extract; **VSL**: V. soyauxii leave extract.*

Table 1. Information on the collected plant samples.

Samples, (family), and herbarium number [a]	Traditional treatment	Part used	Area of plant collection	Known bioactive (or potentially active) compounds	Screened activity for crude plant extracts and/or bioactive compounds
Myrianthus arboreus P. Beauv. (Moraceae) ; 55499 HNC	Dysentery, diarrhoea, wounds, boils, dysmenorrhoea, incipient hernia, vomiting, malaria, fever, cough, muscular pains, fractures, haemorrhoids [18] ; diabetes [19].	Fruits, leave, bark	Melong, Littoral region of Cameroon	Linoleic acids, pentacyclic triterpenoids, euscaphic acid, myrianthic acid, tormentic acid, ursolic acid, ursenoic acid, myrianthinic acid, myrianthiphyllin, cinnamate [18]; cyanogenic glycosides, phytic acid [20]; pentacyclic triterpenes [21]; C-glycosylflavone regio-isomers, isoorientin, orientin, protocatechuic acid, 3,4-dihydroxybenzaldehyde, chlorogenic acid [22].	Antibacterial [20, 23]; antidiabetic [22] ; antiplasmodial [24]; antinociceptive [25]; anticancer [26].
Allanblackia gabonensis Pellegr. (Clusiaceae); 17275 SRF/Cam	Dysentery, cold, toothache pain, rheumatism, inflammations [27].	Flowers, fruits	Lebialem, South-West region of Cameroon	Allan Xanthones A and D; 1,3,6,7-tetrahydroxy-2-(3-methylbut-2-enyl)xanthone, some flavonoids and phytosterols [28, 29].	Antimicrobial and antileishmanial [28]; antibacterial [27, 29]; analgesic and anti-inflammatory [30]; hepatho-nephroprotective and antioxidant [31]; anticancer [32, 33].
Gladiolus quartinianus A. Rich (Iridaceae); 17260 SRF/Cam	Infections of the skin, gut, urogenital system, and upper respiratory tract, gonorrhea, constipation, dysentery [27].	Whole plant	Lebialem, South-West region of Cameroon	Not reported	Antibacterial [27] ; anticancer [32].
Peperomia fernandopoiana C.DC. (Piperaceae); 7171 SRF/Cam	Gastrointestinal disorders, sterility [34].	Whole plant	Lebialem, South-West region of Cameroon	Not reported	Anticancer [32]; antibacterial [34].
Vepris soyauxii Engl. (Rutaceae) 18394 SFR/Cam	Fibromyomes, stomachache, malaria [34].	Leave	Melong, Littoral region of Cameroon	Maculin, flindersiamin, skimmianin, (-) ribalinin , (+)-isoplatydesinin and araliopsin [35] ; obacunone, kihadanin B [36].	Antibacterial [34] ; anticancer [32, 36]; antiandrogenic [37].

[a]***HNC**: Cameroon National Herbarium; **SRF/Cam**: Société des Réserves Forestières du Cameroun.*

Table 2. Total phenolic and flavonoid contents of the methanol extracts of the different plant extracts

Plants (Family)	Samples	TPC (mg GAE/g)	TFC (mg CE/g)
A. gabonensis	Flowers (AGFl)	138.59±10.39^{d}	42.16±0.89^{d}
	Fruits (AGF)	110.02±10.20^{c}	66.54±2.12^{f}
G. quartinianus	whole plant (GQW)	74.53±9.12^{b}	25.48±0.41^{b}
P. fernandopoiana	whole plant (PFW)	196.01±10.25^{f}	21.15±1.57^{a}
V. soyauxii	Leave (VSL)	67.89±1.80^{b}	27,06±2,19^{b}
	Fruits (MAF)	49.71±2.64^{a}	25.09±1.98^{b}
M. arboreus	Leave (MAL)	165.71±10.68^{e}	38.15±2.24^{c}
	Bark (MAB)	158.79±3.60^{e}	48.13±1.65^{e}

***TPC**: total phenolic content; **FC**: Flavonoid content; **mgGAE/g**: milligram galic acid equivalent/gram of extract; **mgCE/g**: milligram catechin equivalent/gram of extract. Values that do not carry similar superscript letters in a column are significantly different ($p < 0.05$).*

Table 3. Scavenging capacity of DPPH radical by the different plant extracts and ascorbic acid.

Extract concentration (µg/mL)	Samples[a], % inhibition of DPPH radical and IC_{50} (µg/mL)								
	AGFl	AGF	GQW	PFW	VSL	MAF	MAL	MAB	Ascorbic acid
12.5	88.61±5.23 [a]	89.55±0.24^{a}	70.48±5.16^{a}	67.05±1.73^{a}	48.67±5.63^{a}	23.26±0.73^{a}	79.77±6.30^{a}	85.35±2.28^{a}	79.40±0.74^{a}
25	94.62±1.36 [b]	91.69±0.24^{b}	76.24±3.90^{a}	67.98±4.07^{a}	54.14±6.67^{a}	23.67±2.21^{a}	85.66±0.63^{ab}	88.23±1.68^{b}	86.68±1.12^{b}
50	95.51±0.67^{b}	94.46±0.27^{c}	84.91±0.64^{b}	89.76±3.33^{b}	80.48±7.49^{b}	44.10±5.99^{b}	85.41±2.75^{ab}	88.91±1.25^{b}	88.09±0.25^{c}
100	95.86±0.90^{b}	96.12±0.14^{d}	89.38±2.10^{bc}	97.77±2.27^{bc}	88.69±1.51^{bc}	95.17±3.17^{c}	86.82±1.00^{b}	92.41±0.13^{c}	91.56±0.50^{d}
200	96.00±1.02^{b}	96.60±0.14^{e}	92.05±0.61^{c}	94.61±3.14^{c}	96.43±0.13^{c}	96.27±0.95^{c}	91.04±0.90^{b}	92.71±0.60^{c}	94.29±0.50^{e}
IC_{50} (µg/ml)	**0.41**	**0.04**	**2.57**	**9.55**	**15.85**	56.23	**0.11**	**0.03**	**0.42**

[a] ***AGFl**: A. gabonensis flower extracts; **AGF**: A. gabonensis fruit extract; **GQW**: G. quartinianus whole plant extract; **PFW**: P. fernandopoiana whole plant extract; **VSL**: V. soyauxii leave extract; MAF: M. arboreus fruit extract; MAL: M. arboreus leave extract; MAB: M. arboreus bark extract. IC_{50} : sample concentration providing 50% inhibition. Values that do not carry similar superscript letters in a column are significantly different ($p < 0.05$).*

Table 4. Minimal inhibitory concentration**/**minimum fungicidal concentration of the different plant extracts and nystatin.

Fungal strains	MIC/MFC[a] of the tested extract[b] (µg/mL)								
	AGFl	**AGF**	**GQW**	**PFW**	**VSL**	**MAF**	**MAL**	**MAB**	**Nystatin**
Candida albicans ATCC9002	256/1024	512/na	256/na	1024/na	1024/na	1024/na	512/na	128/1024	1/8
Candida tropicalis ATCC750	1024/na	512/na	1024/na	128/1024	na/na	512/na	512/na	128/512	2/8
Candida parapsilosis ATCC22019	na/na	1024/na	512/na	na/na	na/na	na/na	1024	na/na	4/8
Candida guilliermondii	na/na	512/na	1024/na	1024/na	na/na	1024/na	1024/na	1024/na	4/16
Cryptococcus neoformans IP95026	na/na	na/na	na/na	1024/na	1024/na	1024/na	1024/na	1024/na	8/32

[a]***MIC/MFC****: minimal inhibitory concentration/minimum fungicidal concentration.* [b]***AGFl****: A. gabonensis flowers;* ***AGF****: A. gabonensis fruit;* ***GQW****: G. quartinianus whole plant ;* ***PFW****: P. fernandopoiana whole plant ;* ***VSL****: V. soyauxii leave; MAF: M. arboreus fruit;* ***MAL****: M. arboreus leave;* ***MAB****: M. arboreus bark.* ***na:*** *not active up to 1024 µg/mL.*

Conclusion

The present work was designed to assess the antioxidant and antifungal activities of the methanol extracts of selected medicinal plants. The overall results obtained revealed that the tested extracts have moderate to high antioxydant actititiy and low to moderate antifungal property. Therefore, the methanol extracts of the leave and bark of *Myrianthus arboreus* as well as fruit and flower of *Allanblackia gabonensis* possess higher antioxidant activities whereas only the the methanol extracts bark of *M. arboreus* was most active against the tested fungi.

Abbreviations

AGF: *Allanblackia gabonensis* fruit extract
AGFl: *Allanblackia gabonensis* flowers extract
ATCC: American Type Culture Collection
DMSO: Dimethyl sulfoxide
DPPH: 2,2 Diphenyl 1 picrylhydrazyl
GQW: *Gladiolus quartinianus* whole plant extract
HNC: *Herbier National du Cameroun*
MAB: *Myrianthus arboreus* bark extract
MAF: *Myrianthus arboreus* fruit extract
MAL: *Myrianthus arboreus* leave extract
MeOH: Methanol
MIC: Minimal inhibitory concentration
MIC: Minimal inhibitory concentration
PFW: *Peperomia fernandopoiana* whole plant extract
SDA: Sabouraud dextrose agar
SDB: Sabouraud dextrose broth
VSL: *Vepris soyauxii* leave extract

Authors' Contribution

AGF collected the plant samples and prepared the extracts; AGF and SSA designed and carried out the experiments; AGF, SSA and GSSN analyzed the data and wrote the manuscript; JRK supervised the work and revised the manuscript. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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