Original Research Article

Quantification of the antiradicalpotential and evaluation of the antibacterialactivity of the stem and root barks of *Cassia sieberiana*:a plant used in traditionalmedicine

ABSTRACT :

Aims : The general objective of thisstudywas to justify or invalidate the use of *C. sieberiana* stems and roots as naturalantibiotics and antioxidants capable of treatingtraditional pathologies.

Methodology: Specifically, extractions were first carried out with water, ethanol and the binary water/ethanol mixture from stem and root barkpowders. The variousextractsobtainedwerethenused to assessantioxidantactivity by spectrophotometry and antibacterialactivity by the solid-state diffusion and liquid-state dilution methods.

Results: The yields of the different extractions gave values rangingfrom 17.02±0.79 to 27.05±0.40 %. Antioxidantactivity shows that the stems and roots of *C. sieberiana*contain a notable antioxidant profile. However, the antioxidantactivity of the stems can beconsideredslightlybetterthanthat of the roots. The antibacterialactivityassessedshowedthat*C. sieberiana*stem and root extractswere active against the Staphylococcus aureus strainstested. The stem extractswereabsolutelybactericidal, while the root extractswerebacteriostatic. However, stem extractswere more effective than root extracts.

Conclusion: We can concludethatbothorgans of C. sieberiana, but more strongly the stems, couldbeused to treatbacterial infections and diseaseslinked to oxidative stress.

Key words: Cassia sieberiana, antioxidantactivity, antibacterialactivity, Ivory Coast.

1. INTRODUCTION

Plant organs are subject to biotic stresses of microbialorigin. This stress can lead to the formation of free radicalswhich, through successive reactions, can cause the plant to wither and/or die [1]. Despitethis constant stress, plants can survive, develop and multiply [2]. This impliesthat plants developnatural substances withantioxidant and antimicrobialproperties, whichcouldjustifytheir long-standing use by humans to feed, defend and treatthemselves [3]. Withthis in mind, we are interested in the roots and stems of *Cassia sieberiana*with a view to confirming or invalidatingits use againstdiseaseslinked to oxidative stress and bacteria. Infectiousdiseases are one of the leading causes of mortalityworldwide. Estimates show thatinfectiousdiseases are responsible for 14 milliondeaths a yearworldwide, and account for 43% of deaths in developing countries [4, 5]. It has also been notedthatbacteriaalone are responsible for 70% of thesedeaths [6]. As for free radicals, they are the ultimate cause of numerous pathologies and are thought to be at the root of certain chronicdiseases (cardiovascular, neurodegenerative and Alzheimer'sdiseases, cancer and diabetes)

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as well as ageing [7, 8, 9]. However, antioxidantmolecules of syntheticorigin do exist, but they are currentlyoftencalledinto question because of the potentialtoxicologicalrisksthey may pose [10, 11]. Similarly, with the advent of modern medicine and itsadvances in the treatment of bacterialdiseases, syntheticantibiotics have been developed, but these are increasinglyencounteringresistancefrombacteria [12]. This growingmulti-resistanceis due to the continued and evenuncontrolled use of conventionalantibiotics [6, 13, 14, 15]. To alleviatethis situation, whichcomes on top of the high cost of modern medicines, manyhopes are beingpinned on the secrets of medicinal plants and the emergence of an alternative medicinebased on these plants. The aim of thisresearchis to quantitativelyassess the antioxidantactivity of aqueous, ethanolic and hydro-ethanolicextracts of *Cassia sieberiana* stem and root bark, and to evaluatetheirantimicrobialactivity.

2. MATERIAL AND METHODS

2.1. Material

2.1.1. Plant material

The plant material consists of stem and root barks of *Cassia sieberiana.* The various organs were harvested in February 2022 in the town of Korhogo (9° 27‘ 28‘‘ North, 5° 37’ 46‘‘ West), specifically in the village of Kapékaha. The various organs were dried for 5 days in a room at room temperature, ground in a mortar and then sieved. The fine powders obtained were used to prepare the various extracts to be tested.

2.1. 2. Laboratoryequipment and chemicalproducts

The laboratoryequipmentconsisted of laboratoryglassware, an oven, an electronic balance, a hot plate and a JENWAY 7315 spectrophotometer. The analytical-grade chemicalsconsisted of ethanol, acetone, DPPH and ascorbicacid (vitamin C).

2.1.4. Bacterialstrains

Five (05) bacterialstrainswereused:

- 03 *Staphylococcus aureus*species:*S. aureus* ATCC 29213, *S. aureus* 06 UB/22 and *S. aureus* 27 UB/22: all collectedfrominfected skin.
- 01 *Pseudomonas aeruginosa*species:*P. aeruginosa* 97 UB/22.
- 01 species of *Enterobacteriaceae*:*Escherichia coli* 78 UB/22.

2.2. Methods

2.2.1. Acquisition of aqueous, ethanolic and hydro-ethanoliccrudeextracts

Aqueouscrudeextracts(Aq):a mass of 10 g of powderfromeachorgan (stems and roots) of *Cassia sieberiana*was mixed with 100 mL of distilled water. The decoctionswereobtainedafter 20 min of boiling at temperaturesvaryingprogressively up to 120°C. After filtration, the decoctionswereplaced in an oven at 50°C for 4 days to obtain the aqueouscrudeextracts.

Ethanoliccrudeextracts(Et):10 g of powderfromeachorganstudiedwasmaceratedin 100 mL of ethanol for 24 h. After filtration, the differentmaceratewereplaced in an oven at 50°C for 4 days to obtain the ethanoliccrudeextracts.

Hydro-ethanoliccrudeextracts(H-et):10 g of eachorganpowderwasmaceratedin 100 mL of a binaryethanol/water mixture (70 mL/30 mL) for 24 h. After filtration, the macerateswereincubated at 50°C for 4 days to obtain the hydro-ethanoliccrudeextracts.

The variousaqueous, ethanolic and hydro-ethanoliccrudeextracts of the stem and root barks of *C. sieberiana*werethenused to evaluate the antioxidant and antibacterialactivities.

2.2.2. Assessment of antioxidantactivityagainst DPPH by spectrophotometry

The antioxidantpotential of crudeaqueous, ethanolic and hydro-ethanolicextracts of the stem and root barks of *C. sieberiana* Cassia wasassessedusing the Blois method [16].

DPPH was solubilised in absolute ethanol to obtain a solution with a concentration of 0.03 mg/mL. Different concentration ranges (2 mg/mL, 1 mg/mL, 0.5 mg/mL, 0.25 mg/mL, 0.125 mg/mL and 0.0625 mg/mL) of each extract were prepared in absolute ethanol. 2.5 mL of plant extract and 1 mL of ethanolic solution of DPPH were added to dry, sterile tubes. After shaking, the tubes were placed in a dark place for 30 min. The absorbance of the mixture was then measured at 517 nm against a blank consisting of 2.5 mL absolute ethanol and 1 mL DPPH solution. The reference control, ascorbic acid (vitamin C), was treated under the same conditions as the plant extracts. The percentages of DPPH radical inhibition by plant extracts and vitamin C were calculated using the following formula:

$$\mathbf{I(\%) = (A_b - A_e) / A_b \times 100}$$

I: inhibition percentage
$\mathbf{A_b}$: absorbance of the white
$\mathbf{A_e}$: absorbance of the sample

The concentrations required to trap 50% (IC50) of the DPPH radical are determined on the graphs representing the percentage inhibition of the DPPH radical as a function of the concentrations of the plant extracts or vitamin C.

2.2.3. Study of antibacterialactivity

The antibacterialactivity of aqueous, ethanolic and hydroethanolicextractswasstudiedin 4 stages:

- The first involvedcarrying out a sterility test on the different plant extractsstudied. To 10 mL of thioglycholatebrothwasadded 0.1 g of each plant extract to betested, and the mixture wasincubated at 37°C for 24 h. A nutrient agar plate wastheninoculatedwith the broth and incubated at 37°C. The substance isdeclaredsterile if no colonies are visible on the agar [17] ;
- - The second stage was the choice of bacteria. The strainshad to beyoung for the results to be reliable. This involvedstreak inoculation using a loopcalibrated to 2 µL on Mueller Hinton agar, followed by incubation at 37°C for 24 hours. Aftergrowth, the youngbacteriawereused for the experiment;
- The thirdstepwas to determine the antibacterialefficacy of the extractsusing the methoddescribed by Wiegand et al [18] and Biyiti et al [19]. The disheswere first inoculatedwith the bacterialstrains. Wells werethendug in the culture media, intowhich the extracts to betestedwereadded at a concentration of 50 mg/mL. Once the media were dry, theywereincubated at 37°C for 24 hours. The presence of a zone of inhibition greaterthan 08 mm in diameterindicatesthat the extract has antibacterialactivity;
- The fourthstepwas to determine the MIC and MBC using the methodsdescribed by Dosso and Faye-kette [20]. Thesebiologicalparameterswereused to verify the bactericidal or bacteriostaticproperties of the extracts.

3. RESULTS

3.1. Extraction yields

The various extractions carried out by maceration and decoctionwith*Cassia sieberiana* stem and root barkpowderswereused to calculate the different extraction yields. The values obtained, rangingfrom 17.02±0.79 to 27.05±0.40 %, are given in Table 1.

Table 1:Yields of different*Cassia sieberiana*extracts

	Stems	**Roots**
Aqueousextracts (Aq)	**18.17±1.00 %**	**27.05±0.40 %**
Ethanolicextracts (Et)	**17.02±0.79%**	**19.46±0.18%**
Hydro-ethanolicextracts (H-et)	**22.02±1.40%**	**17.46±0.43%**

3.2. Antioxidantactivity by spectrophotometry

3.2.1. Percentage inhibition of vitamin C and crude plant extracts

The different percentages of DPPH radical inhibition by aqueous, ethanolic and hydro-ethanolicextracts and vitamin C are shown in Figures 1 and 2.

The differentextracts show a significantantioxidantpotentialwhatever the concentration of the extract. Inhibition percentages for plant extractsrangedfrom 36.349 ± 1.224 to 98.558 ± 0.219% and for vitamin C from 63.913 ± 0.131 to 99.705 ± 0.000% at the same concentration ranges.

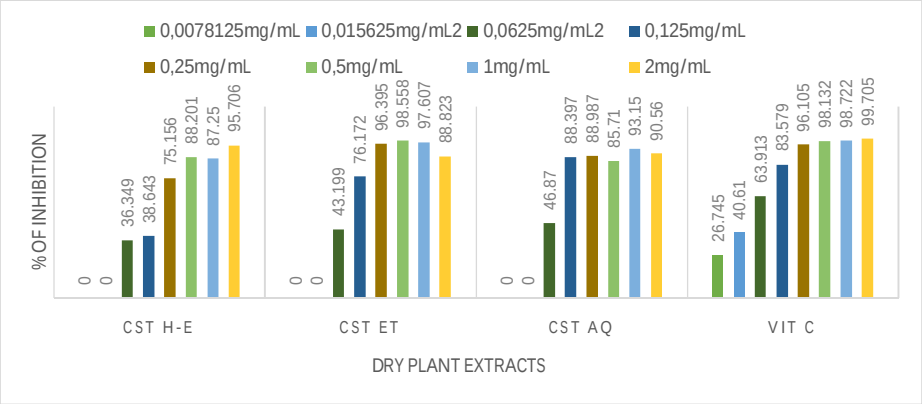


Fig 1. DPPH radical inhibition by aqueous, ethanolic and hydro-ethanolicextracts of *C. sieberiena* stem bark and vitamin C.

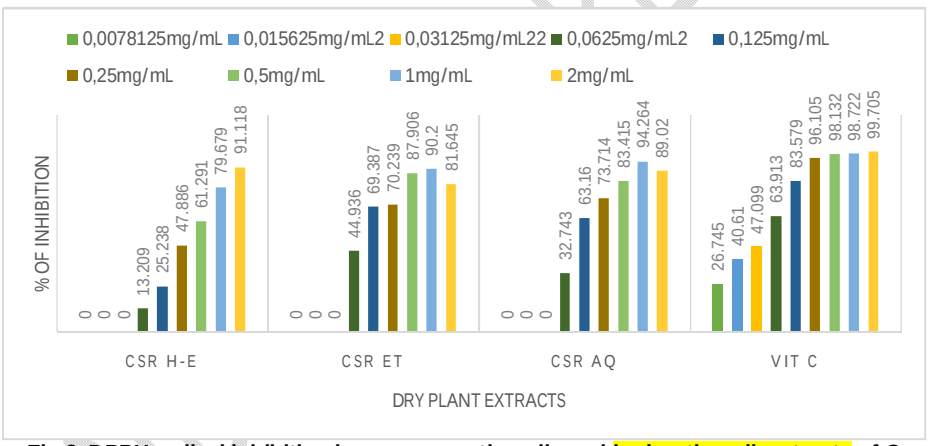


Fig 2. DPPH radical inhibition by aqueous, ethanolic and hydroethanolicextracts of *C. sieberiena* root bark and vitamin C.

3.2.2. Determination of IC50s for vitamin C and plant extracts

The inhibition percentages wereused to calculate the sample concentrations required to reduce 50% of the DPPH radicals. The IC50s of the various plant extractsstudied and of vitamin C weredeterminedgraphicallyusing EXCELL software. The IC50 values obtained are shown in Table 2. Those for the plant extractsvarybetween 0.07539 mg/mL and 0.28943 mg/mL, whilethat for vitamin C is 0.03664 mg/mL.

Table 2: IC50 values (mg/mL) for plant extracts and vitamin C

Extracts	CST H-et	CST Et	CST Aq	CSR H-et	CSR Et	CSR Aq	Vit C
IC50 (mg/mL)	**0.16388**	**0.07539**	**0.09776**	**0.28943**	**0.07544**	**0.09796**	**0.03664**

3.3. Antibacterialactivity

3.3.1. Sterility of plant extracts

The sterility tests on the plant extractsconsisted in checking thattheywere not contaminated. No colonies wereobserved on the various agar plates after 24 h. As a result, the crudeaqueous, ethanolic and hydro-ethanolicextracts of *Cassia sieberiana* stem and root barks do not appear to show anysigns of contamination.

3.3.2. Antibacterialactivity of plant extracts in liquids

The antibacterialactivity in a solid medium wasused to investigate the sensitivity of the bacteria to aqueous, ethanolic and hydro-ethanolicextracts of *Cassia sieberiana* stem and root bark at a concentration of 50 mg/mL, and then to check theirbehaviour in relation to the variousantibioticsused. Antibioticswerechosen on the basis of theirspecificity for the different groups of bacteriaused in the tests. Cefoxitin (FOX) and erythromycin (E) wereused for *Staphylococcus aureus*. For *Pseudomonas aeruginosa*, ceftriaxone (CRO) and ticarcillin+clavulanicacid (TCC) wereused.Finally, imipenem (IPM) and ciprofloxacin (CIP) weretested on Enterobacteriaceaespecies. Theseantibioticsacted as positive controls and distilled water as a negative control.

The results of bacterialsensitivity to aqueous, ethanolic and hydro-ethanolicextracts of *C. sieberiana* stem and root barks and antibioticsshown in Figure 3 arereported in Table 3.

The diameters of the inhibition discs for aqueous, ethanolic and hydro-ethanolicextractsrangedfrom 06.0±0.0 to 13.67±0.44 mm and those for antibioticsfrom 06.0±0.0 to 28.00±0.0 mm.

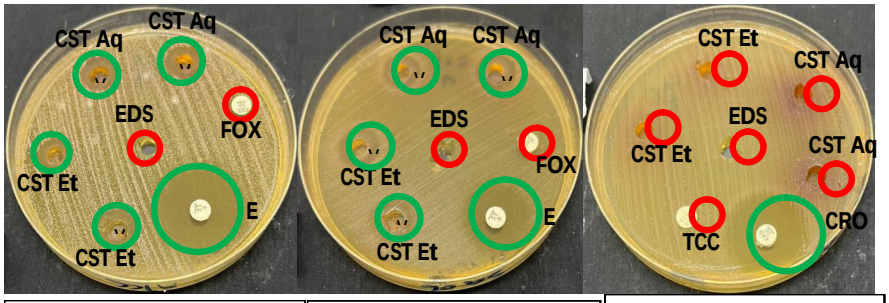


Fig 3. Susceptibilitytesting of studyextracts and antibioticsagainstbacteria

: *Sensible* ; : *Resistant*

Table 3: Inhibition diameters (mm) of bacteriaagainstaqueous, ethanolic and hydro-ethanoliccrudeextracts and referenceantibiotics

	C.S.T			C.S.R									
	Aq	Et	H-et	Aq	Et	H-et	FOX	E	CRO	TCC	IPM	CIP	S.d.w
S.a ATCC 29213	13	11	11	10	09	09	06	23					06
	14	13	11	11	08	09	06	24					06
	14	12	11	11	09	09	06	22					06
	13.67	**12.00**	**11.00**	**10.67**	**09.67**	**09.00**	**06.00**	**23.00**					**06.00**
M.s.d.	*0.44*	*0.67*	*0.00*	*0.44*	*0.44*	*0.00*	*0.00*	*0.67*					*0.00*
S.a 06 UB/22	12	14	13	10	08	09	06	20					06
	13	13	12	11	10	09	06	20					06
	13	14	12	11	09	09	06	20					06

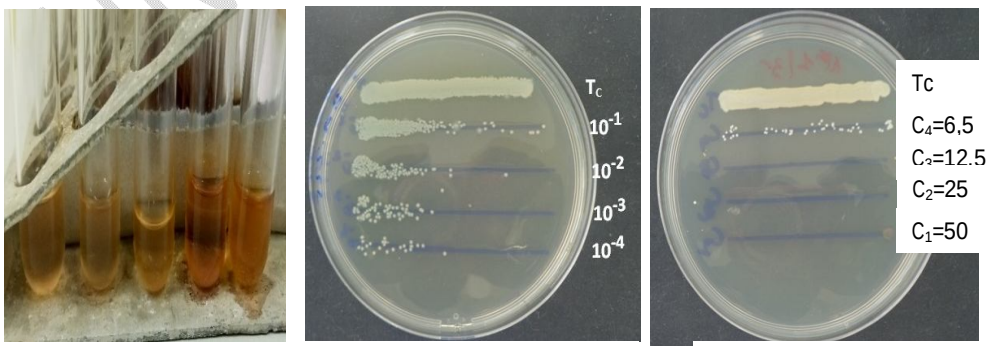
	12.67	**13.67**	**12.33**	**10.67**	**09.00**	**09.00**	**06.00**	**20.00**					**06.00**
M.s.d.	*0.44*	*0.44*	*0.44*	*0.44*	*0.67*	*0.00*	*0.00*	*0.00*					*0.00*
S.a 27 UB/22	13	13	11	08	08	06	06	18					06
	14	12	10	09	08	06	06	18					06
	14	13	11	09	08	06	06	19					06
	13.67	**12.67**	**10.67**	**08.67**	**08.00**	**06.00**	**06.00**	**18.33**					**06.00**
M.s.d.	*0.44*	*0.44*	*0.44*	*0.44*	*0.00*	*0.00*	*0.00*	*0.44*					*0.00*
E. coli 78 UB/22	06	06	06	06	06	06			24	06			06
	06	06	06	06	06	06			23	06			06
	06	06	06	06	06	06			24	06			06
	06.00	**06.00**	**06.00**	**06.00**	**06.00**	**06.00**			**23.67**	**06.00**			**06.00**
M.s.d.	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*			*0.44*	*0.00*			*0.00*
P. a 97 UB/22	06	06	06	06	06	06					06	28	06
	06	06	06	06	06	06					06	28	06
	06	06	06	06	06	06					06	28	06
	06.0	**06.0**	**06.0**	**06.0**	**06.0**	**06.0**					**06.0**	**28.0**	**06.0**
M.s.d.	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*					*0.00*	*0.00*	*0.00*

C.S.T : Cassia sieberiana stem bark; C.S.R : Cassia sieberiana root bark; H_2O : water ; EtOH : Ethanol ; FOX : Cefoxitin ; E : Erythromycin ; CRO : ceftriaxone ; TCC : Ticarcillin+Clavulanicacid; IPM :Imipenem; CIP : Ciprofloxacin ; S.d.w : Steriliseddistilled water; S.a ATCC 29213 : Staphylococcus aureus ATCC 29213 ; S.a 06 UB/22 : Staphylococcus aureus 06 UB/22; S.a 27 UB/22 : Staphylococcus aureus 27 UB/22; E. coli 78B/22 : Escherichia coli 78 UB/22, et P. a 97 UB/22 : Pseudomonas aeruginosa 97 UB/22 ; M.s.d.:Mean standard deviation.

3.3.3. Antibacterialactivity in liquids

The antibacterialactivity in liquid medium wasused to determine the antibacterialparameters MIC and MBC respectively minimum inhibitory concentration and minimum bactericidal concentration of the plant extractsthatshowedactivity on the bacterialstrainsused. Thesewere the aqueous, ethanolic and hydro-ethanolicextracts of the stems and roots of *Cassia sieberiana* on the three*Staphylococcus aureus*used in thisstudy.

Figure 4 illustrates the techniques used to determineantibacterialparameters and their values are given in Table 4.



Petri dish A Petri dish B

Fig 4. Illustration of the determination of MIC and MBC of plant extracts

Table 4: Antibacterialparameters of plant extracts on the strainstested

Extracts	Strains	MIC mg/mL	MCB mg/mL	MBC/MIC	Interpretation
CST Aq	*S.a ATCC 29213*	**6.25**	**6.25**	**1**	**Absolutebactericide**
	S.a 06 UB/22	**6.25**	**6.25**	**1**	**Absolutebactericide**
	S.a 27 UB/22	**6.25**	**6.25**	**1**	**Absolutebactericide**
CST Et	*S.a ATCC 29213*	**6.25**	**6.25**	**1**	**Absolutebactericide**
	S.a 06 UB/22	**6.25**	**6.25**	**1**	**Absolutebactericide**
	S.a 27 UB/22	**6.25**	**6.25**	**1**	**Absolutebactericide**
CST H-et	*S.a ATCC 29213*	**6.25**	**6.25**	**1**	**Absolutebactericide**
	S.a 06 UB/22	**6.25**	**6.25**	**1**	**Absolutebactericide**
	S.a 27 UB/22	**6.25**	**6.25**	**1**	**Absolutebactericide**
CSR Aq	*S.a ATCC 29213*	**12.5**	**50**	**4**	**Bacteriostatic**
	S.a 06 UB/22	**12.5**	**50**	**4**	**Bacteriostatic**
CSR Et	*S.a ATCC 29213*	**12.5**	**50**	**4**	**Bacteriostatic**
	S.a 06 UB/22	**12.5**	**50**	**4**	**Bacteriostatic**
CSR H-et	*S.a ATCC 29213*	**12.5**	**50**	**4**	**Bacteriostatic**
	S.a 06 UB/22	**12.5**	**50**	**4**	**Bacteriostatic**

MIC:*Minimum Inhibitory Concentration;* ***MBC:*** *Minimum Bactericidal Concentration.*

4. DISCUSSION

This studybeganwith extractions by maceration and decoctionusing*Cassia sieberiana* stem and root barkpowders. The highestyieldwasobtainedfrom the rootsusing the aqueousdecoction, with an extraction percentage of 27.05±0.40% comparedwith 18.17±1.00% for the stems. The rootsalsoshowed the highestyield (19.46±0.18%) duringethanolicmacerationcomparedwith 17.02±0.79% for the stems. It wouldappearthat the rootsconcentrate the phytocompoundsbetterthan the stems when water and ethanol are used as extraction solvents.
On the other hand, hydro-ethanolmacerationshowed a higheryield for *C. sieberiana* stems with 22.02±1.40% comparedwith 17.46±0.43% in the roots. It wouldappearthat the stems concentrate the phytocompoundsbetterthan the rootswhen the binary water/ethanol mixture (70/30) isused as the extraction solvent.
Thus, aqueousdecoctionisfavourable for the extraction of phytocompoundsfrom C. sieberiana root barks, whereashydroethanolmacerationis the best for stem barks.

The antioxidantactivity of the plant extractswasthenassessedspectrophotometrically. This analysisconsisted of determining the inhibition percentages of the extractswith respect to the DPPH radical and the inhibitory IC50 concentrations.
This studyshowed, through the values of the inhibition percentages, that the various plant extractsstudiedshowedantioxidantactivitywhatever the concentration of the extract. This oxidisingactivityobserved for all the plant extractsisthought to be due to the synergistic action of the secondarymetabolitespresent in the stems and roots of *C. sieberiana*. In fact, severalresearchers have identifiednumerouschemical compounds in the stems and roots of *C. sieberiana* [21, 22] whoseantioxidantpotential has already been demonstrated. Theseincludephenolicacids, tannins, coumarins, flavonoids, saponins, alkaloids, sterols and terpenes [23, 24, 25, 26, 27].
These inhibition percentages, whichrepresent the extract'scapacity to trap free radicals, wereused to determine the IC50. The IC50 provides more information about the antioxidant quantification of extracts. For an extract, thischemicalquantityrepresents the value of its concentration thatresults in a 50% loss of DPPH activity [28]. The lower the IC50, the greater the antioxidantactivity of the extract.

We note that CI50 (CST Et) < CI50 (CST Aq) < CI50 (CST H-et) and CI50 (CSR Et) < CI50 (CSR Aq) < CI50 (CSR H-et). This meansthat for bothorgans, the antioxidant power of the ethanolicextractisgreaterthanthat of the aqueousextract, which in turnisgreaterthanthat of the hydro-ethanolicextract. However, vitamin C, the referencemoleculewith the lowest IC50, has the best antioxidant power.
Comparison of the antioxidantactivity of extractsfrom stems and extractsfromroots shows that the IC50s of ethanolicextractsfrom stems and roots are equal (IC50=0.075 mg/mL). However, the antioxidant power of the stem hydroethanolextract (IC50=0.164 mg/mL) wasgreaterthanthat of the root hydroethanolextract (IC50=0.289 mg/mL).
At the end of this quantitative analysis of antioxidantcapacity, the crudeaqueous, ethanolic and hydro-ethanolicextracts of the stems and roots of *Cassia sieberiana*revealed a significant DPPH neutralisingcapacity, but thiswasgreaterwith the aqueous and ethanolicextracts of thesetwoorgans. Theseantioxidantscouldthereforeberecommended for preventing or curbing the damage caused by oxidative stress, namely cancer, acceleratedageing, arterial hypertension, Alzheimer'sdisease, Parkinson'sdisease and diabetes [29, 30]. Theseresultsseem to justify the de facto use of thesetwoorgans of *C. sieberiana* in traditionalmedicineagainst pathologies linked to oxidative stress.

Finally, the antibacterialactivity of the plant extractsstudied, all of whichweredeclaredsterile, wasevaluated. This studywasthenused to determine the inhibition diameters of the plant extractsagainstbacteriausing the solid medium diffusion method, and the MIC and MBC parameters of thosethatwere effective using the liquid medium dilution method.
The solid-state diffusion test wascarried out on three (03) *Staphylococcus aureus*, one (01) *Pseudomonas aeruginosa* and one (01) species of *Enterobacteriaceae*. The tests carried out on *Staphylococcus aureus*showedthatpractically all the inhibition disc diameter values weregreaterthan the limitdiameter (08 mm) [31], except for the hydroethanolextracts of roots on *Staphylococcus aureus* 06 UB/22, whichshowed no activity. This indicatesthatvirtually all the extractsanalysedwere effective against the Staphylococcus aureus used. In fact, a bacteriumissaid to beresistant to an extractwhenits inhibition diameteraroundthisextractislessthan or equal to 8 mm, sensitive if thisdiameterisbetween 9 and 14 mm, very sensitive whenitisbetween 15 and 19 mm and extremely sensitive for a diametergreaterthan 20 mm [31].
In addition, the inhibition diametersobservedindicatethat the aqueous and ethanolicextracts are the most active.
The diameters of the inhibition discs of the stem extractsweregreaterthanthose of the root extracts.
As for the antibioticstested, inhibition diametersrangingfrom 6±0.0 to 23.00±0.67 mm wereobserved. Whileerythromycin (E) exhibited large inhibition diameters on the *Staphylococcus aureus*tested (18.33±0.44 to 23.00±0.67 mm), cefoxitin (FOX) showed total resistance to the same*S. aureus*. This shows that the plant extractsstudied have greaterantibacterialactivitythancefoxitin (FOX).
The action of the various plant extractsstudiedagainst the three*Staphylococcus aureus*couldbejustified by the combined action of the active phytocompoundscontained in thesetwoorgans [21, 22, 32]. The antibacterialactivities of thesephytocompounds have also been published by Ouattara and colleagues [26], Osho [33] and Lunga and colleagues [34]. Severalotherauthors have alsohighlighted the antibacterialactivity of thesesecondarymetabolites [27, 35, 36].
Theseresults are in agreement withthosereported by Schmelzer and colleagues [37]. Theirwork on extracts of *Cassia sieberiana*roots and stems revealedtheirantibacterialactivity [37]. This wouldjustify the traditional use of thesetwoorgans for the treatment of toothache [38], skin diseases, gonorrhoea [39], schistosomiasis, intestinal worms [40] and venerealdiseases [37].
With regard to the tests of thesevarious plant extracts on the *Pseudomonas aeruginosa*species and the *Enterobacteriaceae*species, analysisshowedthattheseextractshad no activity on thesetwobacterialstrains, as their inhibition diameterswere 06.0±0.0 mm. The referenceantibiotics ceftriaxone (23.67±0.44 mm) and ciprofloxacin (28.0±0.0 mm) showedantibacterialactivity, whileticarcillin+clavulanicacid (TCC) and imipenem (IPM) had no activity. Theseresultsfurtherconfirmbacterialresistance to syntheticantibiotics, as shown by severalauthors [6, 12, 13, 14, 15]. In view of the increasingmulti-resistance to syntheticantibioticsobserved in ourwork, itisimperative to explore othertreatment options, in this case plant-basedtreatments. The effective extractswerethenused to determine the CMI and CMB parameters in order to attributebacterialproperties to them. According to Fauchere and Avril, if CMB/CMI = 1, the extractissaid to be 'absolutelybactericidal', if CMB/CMI ≤ 2, the extractisbactericidal, and if CMB/CMI > 2, the extractisbacteriostatic [41]. Thus, we note that all the extracts from the stems are absolute bactericidal on the three *Staphylococcus aureus* strains (*S. aureus* ATCC 29213, *S. aureus* 06 UB/22 and *S. aureus* 27 UB/22), on the other hand those from the roots showed a bacteriostatic character against only *S. aureus* ATCC 29213 and *S. aureus* 06 UB/22.

It can be concluded that the extracts from the stems are more active than those from the roots with regard to the bacterial strains used in our work.

5. CONCLUSION

The aim of this work was to justify or refute the use of *Cassia sieberiana* as a good antibiotic on the one hand and on the other hand as an excellent antioxidant which would be capable of traditionally treating various pathologies. Thus, the evaluation of the antioxidant activity of extracts of stems and roots of *C. sieberiana* shows that these organs contain an antioxidant profile.Quantitatively, the aqueous and ethanolic extracts of the bark of the stems and roots of C. sieberiana have practically the same antioxidant power, on the other hand that of the hydro-ethanolic extract of the stems is greater than that of the hydro-ethanolic extract of the roots.Therefore, the antioxidant activity of the stems can be considered to be slightly better than that observed in the roots.

The antibacterial activity evaluated against five strains showed that the extracts of the stems and roots of *C. sieberiana* are only active against the *Staphylococcus aureus* strains tested (*S.a* ATCC 29213, *S.a* 06 UB/22 and *S.a* 27 UB/22).The extracts from the stems are absolute bactericidal while those from the roots showed a bacteriostatic character. This gives both organs the ability to treat infections caused by *Staphylococcus aureus* bacterial strains. However, extracts from the stems are more effective than those from the roots.

The study of the stem and root bark of *C. sieberiana* showed that these two organs contain antioxidant and antibacterial potential, so they could be used to treat bacterial infections and diseases linked to oxidative stress. However, the antioxidant and antibacterial potentials of the stems are better than those of the roots.
In perspective, this work must continue with the aim of proving the safety of these organs for the human body with a view to formulating a phytomedicine with antioxidant andantibacterial significance which will be accessible to all.

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