



(RESEARCH ARTICLE)



## Inhibition of prostate cancer by plant extracts used in the treatment of malaria in Burkina Faso

Mindiédiba Jean Bangou<sup>1, 2, \*</sup>, A M Emmanuel Thiombiano<sup>2</sup>, Mouniratou Habibou Sibdou Ouedraogo<sup>1</sup> and Georges Anicet Ouedraogo<sup>1, 3</sup>

<sup>1</sup> University of Nazi BONI, Training and Research unit in Sciences and Technology (UFR-ST), Department of Biochemistry and Microbiology, University of Nazi BONI, 01 BP 1091 Bobo-Dioulasso 01, Burkina Faso.

<sup>2</sup> University Joseph Ki-Zerbo, Life and Earth Sciences Training and Research Unit (UFR-SVT), Laboratory of Biochemistry and Applied Chemistry (LA.BIO. C. A), 09 BP 848 Ouagadougou 09, Burkina Faso.

<sup>3</sup> Laboratory for Research and Education in Animal Health and Biotechnology (LARESBA), University of Nazi BONI, 01 BP 1091 Bobo-Dioulasso 01, Burkina Faso.

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### Abstract

**Background and Objectives:** Medicinal plants constitute the major source of malaria treatment in a different region of Burkina Faso, the present study was carried out to determine the potentially anti-malaria plants of the region of Bobo Dioulasso and to assess preliminary investigations on the possible pharmacological applications others than anti-malaria properties assessed by traditional health practitioners.

**Materials and Methods:** Open-ended and structured interviews were used during the ethnobotanical survey. Total phenolics and flavonoids content were estimated using spectrophotometric methods. Antioxidant potential was evaluated using anti-radical and reduction methods while the crystal violet staining technique was used for the determination of extracts cytotoxicity on 22RV1 prostate cancer cells.

**Results:** Ethnobotanical survey highlighted five plants from different families as the most used against malaria. Their extracts have shown a significant potential for trapping radicals by the 2,2'-azino-bis (3-éthylbenzothiazoline-6-sulphonique acid) (ABTS•+) method. The methanolic extract of *T. macroptera* has the highest content of phenolic and flavonoids compounds with respectively 59.94±0.15 mg EAG/100 mg of extract and 5.35±0.05 EQ/100 mg of extract. Methanolic extracts concentration of different plants tested that inhibit 50% of the proliferation of cancer cells 22RV1 proliferation were ranged between 48.34 to 359.1 µg/mL. *E. africana* was the most active 48.34 µg/mL on tested cell strain.

**Conclusion:** Phytochemical composition and antioxidant potential may justify the use of tested plants in the treatment of malaria. Antiradical potential and reduction capacities of tested samples may explain their toxicity 22RV1 prostate cancer cells.

**Keywords:** Ethnobotanical Survey; Malaria; Polyphenols; Antioxidant; Cytotoxicity; Prostate Cancer Cells

\* Corresponding author: Mindiédbiba Jean Bangou

University of Nazi BONI, Training and Research unit in Sciences and Technology (UFR-ST), Department of Biochemistry and Microbiology, University of Nazi BONI, 01 BP 1091 Bobo-Dioulasso 01, Burkina Faso.

## 1. Introduction

Malaria is among the tropical diseases with a high incidence. It is estimated to contribute to more than one million deaths per year in sub-Saharan Africa [1] where it is among the top five diseases causing death in children [2,3]. Burkina Faso is one of the ten countries with the highest number of malaria cases and associated deaths (3% of cases and deaths worldwide). Malaria is responsible for 43% of health consultations and 22% of deaths [4]. It is characterized generally by fever, chills, and flu-like illness [5].

During the malaria crisis, oxidative stress is highly involved in the release of the ferrous ion ( $\text{Fe}^{2+}$ ) from haemoglobin and its crystallization into ferric ion ( $\text{Fe}^{3+}$ ) in the form of hemozoin by the parasite; the release of cytokines and other chemical mediators implicated in the amplification of the release of radicals [6,7]. The current treatment of malaria is based on the use of compounds belonging to the alkaloids molecular class. Unfortunately, the ability to treat and control *Plasmodium falciparum* infection through chemotherapy has been compromised by the advent and spread of resistance to antimalarial drugs [8]. Therefore, the need to find new molecular sources capable of eliminating the pathology remains valid. Confronted with malaria since remote times, the populations of endemic areas have been able to exploit medicinal plants for their benefit and numerous studies have now made it possible to shed light on the mechanisms by which the active compounds of these plants act on the plasmodium. Several medicinal plants are commonly used in the treatment of malaria crisis in Burkina Faso, some of them have already been investigated for this purpose and have shown to be rich in molecules with a strong antioxidant power such as polyphenols [8]. The present study purpose was to identify the plants used for the treatment of malaria in the Bobo Dioulasso region and to assess the content of phenolic compounds as well as the antioxidant power of the most promising.

## 2. Material and methods

### 2.1. Ethnobotanic survey area

Ethnobotanical study was realized in Burkina Faso, specifically in Bobo Dioulasso the economical capital of the country. The investigation area is located in the southwestern part of Burkina Faso, at 11°10' North latitude and 4°18' West longitude, approximatively at 360 km from Ouagadougou (political capital), and an altitude of 445 m, it covers about 136.8 km<sup>2</sup>. The region is mainly inhabited by Bobos, Mossi, Dafing, but other ethnic groups such as Samogo, Fulani and Lobi/Dagara also live there. The local language is Dioulla.

### 2.2. Data collection methods

The survey was carried out during April-June 2019. Open-ended and structured interviews were used during the investigation. The interviews were conducted using the local language (Dioulla) in marketplaces and associations facilities. A total of five groups were interviewed and respondents were male and female gender. Their ages varied from 37 to 72. Questionary was focused on the plants used in the formulation of remedies preconized in the treatment of malaria. Plants specimens were then collected in August 2019 in the classified reserve of Dindéréso (30 km southern direction from Bobo Dioulasso) and their identification was done by a botanist of the department of botanic of the University Nazi-Boni (Bobo Dioulasso, Burkina Faso).

### 2.3. Chemical

All solvents were analytical grade. Agilent Cary 60 UV-Vis Spectrophotometer (Thermo Fisher ; GENESYS 30, USA) was used in all spectrophotometric measurements. Ascorbic acid, ferric chloride, aluminium chloride, potassium acetate, quercetin, DPPH reagent, Folin-Ciocalteu reagent, gallic acid, sodium carbonate, methanol was obtained from Sigma Chemical Co. (St. Louis, MO, USA). Millipore deionized water was used throughout. Thiazolyl Blue Tetrazolium Bromide (Sigma Aldrich, USA), Dimethyl Sulfoxide (Sigma Aldrich, USA).

### 2.4. Plants collection and preparation

Different plants assayed was collected in the classified forest of Dindéréso (Bobo Dioulasso) in August 2019. Dried before being reduced separately to powder. A sample of 15 g of each plant powder was extracted with methanol (Sigma Aldrich). The crushing plants were macerated for 48 h at 4°C. The resulting mixture was then filtered under vacuum and concentrated under reduced pressure in a rotary evaporator at 40°C. The extracts were further dried using a TELSTAR CRYODOS freeze dryer machine then kept at - 20°C for further analysis. A solution of 30 mg/mL of each plant was prepared in 50% ethanol for the following tests.

## 2.5. Determination of total polyphenol content

The total phenolic content was determined according to the method [9]. A 10% solution was prepared from the stock solution (30 mg/mL) using 50% ethanol. 100 µl of this solution was mixed with 200 µl of the Folin-Ciocalteu reagent and 2 mL of de-ionized water then incubated at room temperature for 3 min. A sample of 20% aqueous sodium carbonate (w/w, 1 mL) was then added to the mixture. The total polyphenols were determined after 1h of incubation at room temperature. A negative control sample was also prepared using the same procedure. The absorbance of the resulting blue colour was measured at 770 nm. Results were expressed in mg gallic acid equivalents (GAE) per g dry weight of plant material using an equation obtained from a gallic acid calibration curve. The samples were analyzed in triplicate.

## 2.6. Determination of total flavonoids content

The total flavonoids content in the extracts was determined using the aluminium chloride colourimetric method described by [9]. A known concentration (600 µg/mL) of each extract in methanol was prepared. A 500 µl of the extracts were mixed separately with 0.1 mL of 10% (w/v) aluminium chloride solution, 0.1 mL of 1M potassium acetate solution, 1.5 mL of methanol and 2.8 mL of distilled water. The solutions were thoroughly mixed and incubated at room temperature for 30min. The absorbance of the reaction mixture was measured at 415 nm using a spectrophotometer. The total flavonoids content was determined using a standard curve with quercetin (1 to 25 µg/mL) as the standard. The mean of three readings was used and expressed as mg of quercetin equivalents (QE)/g of the dry extract.

## 2.7. Free-radical scavenging activity

The antioxidant activity of the extracts was assessed based on their ability to scavenge free radicals as described previously by [9]. Various concentrations of plants extract in methanol were prepared (0.15 to 1.5 mg/mL). A methanolic solution of (1-diphenyl-2-picrylhydrazyl) DPPH (3.8 mL, 60 µg/mL) was rapidly mixed with the plant extract (200 µl, 30 mg/mL) in a test tube, with methanol serving as the blank sample and control was also assayed simultaneously. The contents of the tubes were swirled then allowed to stand for 30 min at room temperature in the dark. The absorbance was measured at 517 nm in a spectrophotometer. The scavenging ability of the plant extract was calculated using this equation:

$$\text{DPPH scavenging activity (\%)} = \frac{\text{Abs. control} - \text{Abs sample}}{\text{Abs. control}} \times 100$$

where Abs control is the absorbance of DPPH + methanol; Abs sample is the absorbance of DPPH radical + sample (sample or standard). The total antioxidant activity was expressed as ascorbic acid equivalent/g dry extract. The assay was done in triplicates.

## 2.8. Ferric reducing antioxidant power (FRAP)

The method used is described according to the protocol of [9]. Stock solutions (10 mg/mL) were diluted to the hundredth in distilled water to give a final test concentration of 100 µg/mL. In 3 test tubes, 0.5 mL of the diluted solution and 0.5 mL of distilled water were added to another tube for the blank. A volume of 1.25 mL phosphate buffer (0.2M; pH 6.6) and 1.25 mL potassium hexacyanoferrate [K<sub>3</sub>Fe (CN)<sub>6</sub>] were added to these tubes. This was heated in a water bath at 50°C for 30 min. After this operation, a volume of 1.25 mL trichloroacetic acid (10%) was added and the mixture was centrifuged at 3000 revolutions per minute for 10 min. 0.625 mL of the supernatant were removed from each tube and added to tubes containing 0.625 mL of distilled water. Freshly 125 µL of prepared trichloroferrate [FeCl<sub>3</sub> (0.1%)] was added to the resulting mixture. Three replicates of each sample were analyzed, using a linear regression of ascorbic acid standard curve at 700 nm ( $y = 3.270 \cdot 10^{-3}x$ ;  $R^2 = 0.9990$ ). The ferric reduction capacity was expressed as mg of ascorbic acid equivalent per 100 mg of dry extracts (mg AAE/100 mg).

## 2.9. Antioxidant activity using ABTS method

The radical scavenging capacity of antioxidants for the ABTS<sup>•+</sup> (2,2'-azinobis-3- ethylbenzothiazoline-6-sulphonate) radical cation was determined as described by Dakio et al., 2020, with modifications. For each extract, a methanolic solution (10 mg/ mL) was diluted 100-fold in distilled water. 10 µL of sample (diluted solution) were taken and then mixed with 990 µL of the fresh solution from ABTS<sup>•+</sup>. The whole was incubated in the dark for 15 minutes. Three replicates of each sample were analyzed and were evaluated using a linear regression of gallic acid standard curve at 734 nm in the range from 3.125 to 200 mg/L ( $y = -7.874 \cdot 10^{-4} x + 0.709$ ;  $R^2 = 0.9993$ ). The ABTS<sup>•+</sup> radical scavenging capacity was expressed as mg of ascorbic acid equivalent per 100 mg of dry extracts (mg AAE/100 mg).

## 2.10. Cytotoxicity assay

22RV1 were seeded at a density of 5000 cells/well in a 96-well plate and were allowed to attach overnight. There after, cells were treated with various concentrations of the plant's extracts for 24 h. To assess the cytotoxic effect of the five plants extracts, MTT (3- [4, 5-dimethylthiazol-2-yl]-2, 5-diphenyltetrazolium bromide) assay was carried out. Briefly, cells treated with the plant extracts were exposed to tetrazolium MTT at a concentration of 5 mg/mL. Viable active cells reduced yellow MTT salt to insoluble purple formazan, which was dissolved using DMSO. The absorbance of the coloured solution was measured at a wavelength of 570 nm using an Epoch microplate spectrophotometer (BioTek, USA). The obtained absorbance at 570 nm of both control and treated cells were used to calculate the percentage of cell viability. Assuming 100% viability in control cells, the percentage of treated cells viability will be calculated accordingly to the following equation [10]:

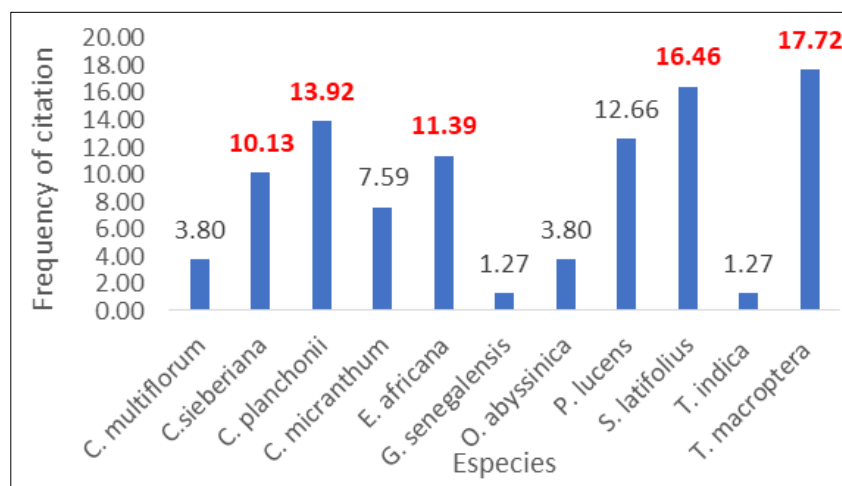
$$\% \text{ of viable cells} = \frac{\text{Absorbance of treated cells}}{\text{Absorbance of control cells}} \times 100$$

## 2.11. Statistical analysis

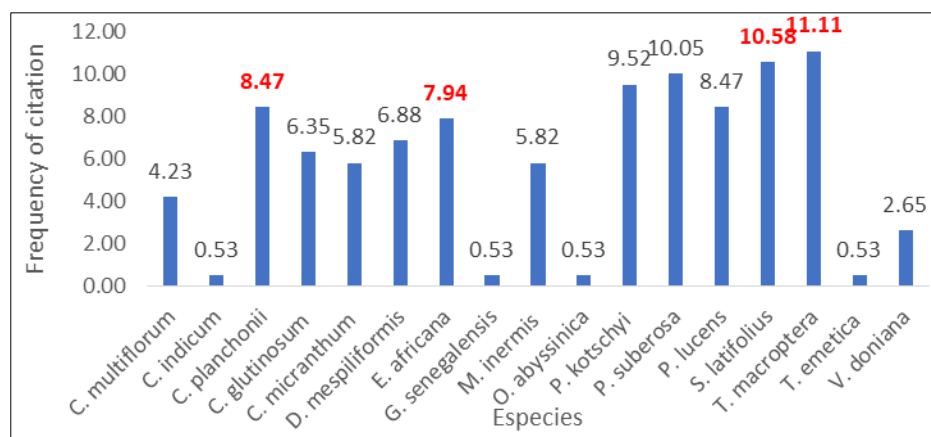
All the reactions were performed in triplicate, and data are presented as mean standard deviation. Data were analyzed by one-way analysis of variance followed by Tukey multiple-comparison test. Analysis was done using XLSTAT7.1 software. A p-value less than 0.05 was used as a criterion for statistical significance.

## 3. Results and discussion

### 3.1. Ethnobotanical survey

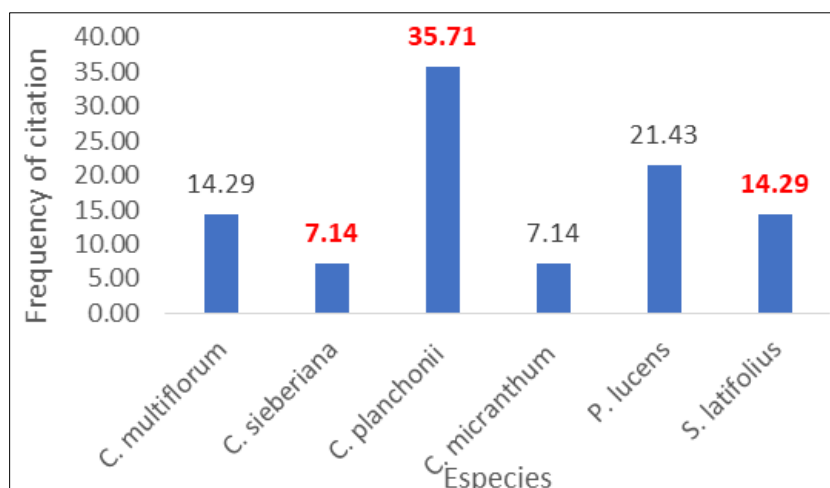


**Figure 1** Citation rate of antimalarial medicinal plants preconized by group 2 traditional health practitioners



**Figure 2** Citation rate of antimalarial medicinal plants preconized by group 1 traditional health practitioners

Ethnobotanical surveys examined the recipes for medicinal plants used in the treatment of malaria. 53 traditional medicine health practitioners from three groups participated in the survey. A graph is dedicated to each group (Figure 1-3) and is based on the citation rate of the species. For the first group, 22 traditional practitioners were interviewed on the recipes of plants that each uses for malaria treatment (Figure 1). A total of 11 plants species were identified in this group. The plants with the best citation rates are *Terminalia macroptera* (17.72%) > *Sarcocephalus latifolius* (16.46%) > *Cochlospermum planchonii* (13.92%) (Figure 1). Concerning the second group composed of 21 practitioners. 21 health practitioners questioned, the information collected highlights the use of 17 medicinal plants for malaria care, the most cited species of which were *Terminalia macroptera* with 11.11% of the citations, followed by *Sarcocephalus latifolius* 10.58% and of *Pteleopsis suberosa* 10.05% (Figure 2). The last group surveyed, consisting of 10 persons, the information collected highlights the use of 6 species with *C. planchonii* (35.71%) ; *Pterocarpus lucens* (21.43%). *S. latifolius* and *C. multiflorum* each had 14.29% of citations (Figure 3). Similar studies in southern Burkina Faso in 2012 on plants used in the treatment of fever-related diseases showed that *Sarcocephalus latifolius* and *Cassia sieberiana* were among the most commonly used species [11]. More recently in Mali [12], a study on the development of a traditional improved malaria drug identified *Entada africana* and *Sarcocephalus latifolius* as the most commonly used species, with 6.24% and 4.16% respectively. These studies corroborate ours and reinforce the results of our ethnobotanical surveys.



**Figure 3** Citation rate of antimalarial medicinal plants preconized by group 3 traditional health

### 3.2. Polyphenol and total flavonoids contents in extracts and fractions of texted samples

The total polyphenol contents and flavonoids contents in the methanolic extracts and the fractions of tested samples expressed in gallic acid equivalent (GAE)/100 mg of extract and quercetin equivalent (QE)/100 mg of the extract are presented in Table 1. *T. macroptera* was the richness methanolic extract in total phenolic (59.94±0.15 mg (GAE)/100 mg) content and total flavonoids contents, while in DCM fractions phenolic and flavonoids content evaluation revealed that *T. macroptera* was the richness in phenolic (32.72±1.07 mg (GAE)/100 mg) and *S. latifolius*, the richness in flavonoids (4.24±0.52mg (QE)/100 mg). Ethyl acetate fractions of *C. sieberiana* was found to be the one with the highest total phenolic content (61.13±2.72 mg (GAE)/100 mg) and *S. latifolius* was the richness in flavonoids contents. Previous studies made by [13] on *C. sieberiana*, found 327.16±3.99 mg GAE/100 mg as the content of total polyphenols and 37.270±2.216 mg QE/100 mg as the concentration of flavonoids in roots ethanolic extracts. Their results compared to our results are lower. These difference between the results could be justified by the type of extract used. Indeed [14] showed in a comparative study that methanol could extract more polyphenolic compounds than ethanol one. In addition to alkaloids and their derivatives, many phenolic compounds have been found very promising in the treatment of malaria [15]. Significant content in phenolic compounds may then justify the use of these species in the treatment of malaria crisis as assumed by the traditional health practitioners questioned.

### 3.3. Antiradical and reduction power of testes medicinal plants

The antiradical and reducing power of different methanolic extracts, DCM and ethyl acetate fractions are presented in Table 2. Through Ferric Reducing antioxidant power evaluation values obtained varied from 410.98±40.10 µmol AAE/g to 5267.59±20.03 µmol AAE/g *C. sieberiana* and *C. planchonii* values were statistically the same, while *T. macroptera* presented the best activity in reducing the ferric ion to ferrous one. Values obtained with dichloromethane and ethyl acetate fractions varied from 121.56±30.06 µmol AAE/g (DCM fraction of *S. latifolius*) to 1673.99±206.03 µmol AAE/g (ethyl acetate fraction of *C. sieberiana*) (Table 2). For the DPPH radical inhibition test, the results varied from

197.44±19.18 µmol EAA/g to 788.13±14.75 µmol EAA/g for the methanolic extracts and from 36.65±19.88 µmol EAA/g to 818.76±3.87 µmol EAA/g for the tested fractions. The ethyl acetate fraction of *C. sieberiana* presented the best result (Table 2).

**Table 1** Total phenolic and flavonoid content of selected medicinal plant used in traditional therapy of malaria in Bobo Dioulasso (Burkina Faso)

	total phenolic content mg (GAE)/100mg			total flavonoids content mg (QE)/100mg		
	Methanolic extract	DCM Fractions	AE Fractions	Methanolic extract	DCM Fractions	AE Fractions
<i>Cassia sieberiana</i> D.C.	50.34±1.11 <sup>b</sup>	20.99 ± 0.74 <sup>c</sup>	61.13± 2.72 <sup>a</sup>	2.96 ± 0.10 <sup>d</sup>	1.03 ± 0.08 <sup>d</sup>	0.88 ± 0.12 <sup>d</sup>
<i>Cochlospermum planchonii</i> Hoot. F.	22.92±0.57 <sup>c</sup>	27.42 ± 0.64 <sup>b</sup>	11.02 ± 0.11 <sup>d</sup>	2.17 ± 0.21 <sup>e</sup>	0.98 ± 0.1 <sup>e</sup>	1.22 ± 0.24 <sup>c</sup>
<i>Entada africana</i> Guill et Perr	11.85±0.45 <sup>e</sup>	13.78 ± 0.45 <sup>e</sup>	25.42 ± 0.62 <sup>b</sup>	5.14 ± 0.09 <sup>b</sup>	2.15 ± 00 <sup>b</sup>	2.01 ± 0.31 <sup>b</sup>
<i>Sarcocephalus latifolius</i> (SM.) E.A. Bruce	16.78±0.12 <sup>d</sup>	18.64 ± 0.43 <sup>d</sup>	11.14 ± 0.37 <sup>d</sup>	3.2 ± 0.23 <sup>c</sup>	4.24 ± 0.52 <sup>a</sup>	3.02 ± 0.16 <sup>a</sup>
<i>Terminalia macroptera</i> Guill et Perr	59.94±0.15 <sup>a</sup>	32.72 ± 1.07 <sup>a</sup>	20.14 ± 0.37 <sup>c</sup>	5.35 ± 0.05 <sup>a</sup>	1.43 ± 00 <sup>c</sup>	1.16 ± 0.05 <sup>c</sup>

Data are Mean ± SEM (n=3), DCM: Dichloromethane, EA: Ethyl acetate. Values showing the same letter in the same column are not significantly different (p < 0.05) from one to another in the same columns

**Table 2** Antiradical and reduction power of extract s and fraction of selected medicinal plants used in the traditional therapy of malaria in Bobo Dioulasso (Burkina Faso)

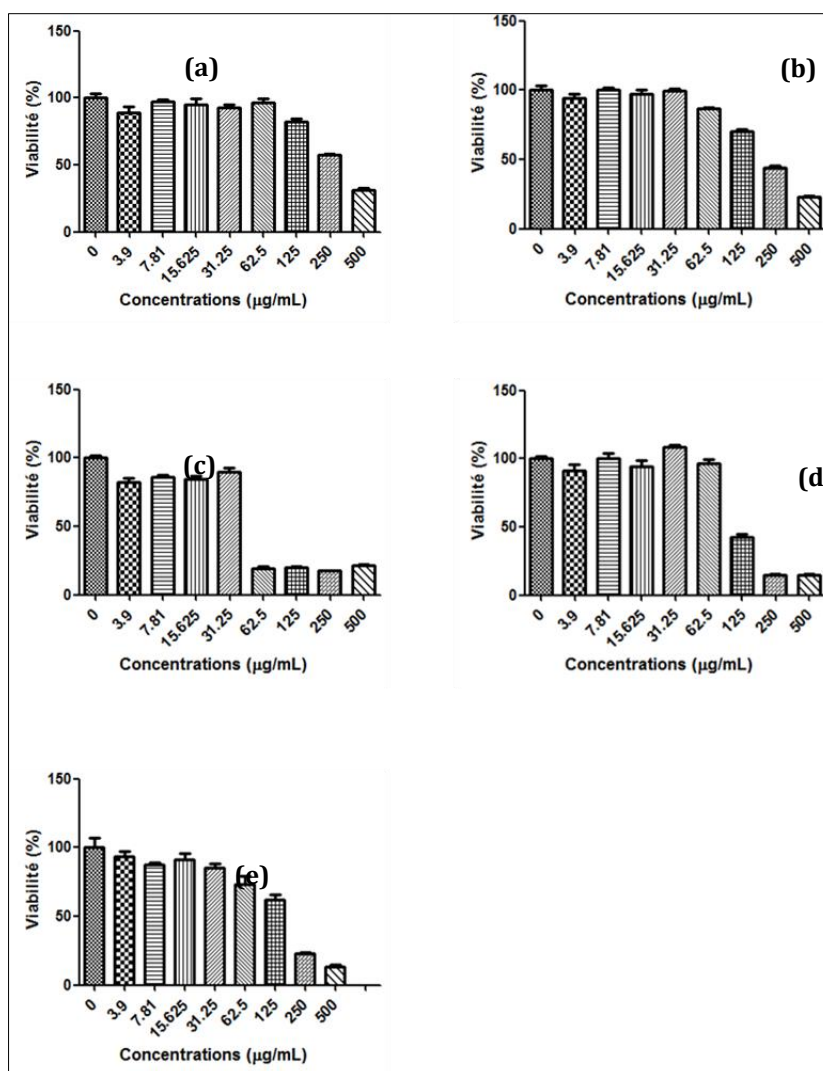
Tests	Extract/fraction	<i>C. sieberiana</i>	<i>C. planchonii</i>	<i>E. africana</i>	<i>S. latifolius</i>	<i>T. macroptera</i>
FRAP (µmol (AAE)/g)	Methanolic extract	1939,18±55,80	1939,40±10,03	1105,62±20,06	410,98±40,10	5267,59±20,03
	DCM fraction	492,03±43,70	625,18±34,72	387,85±10,03	121,56±30,06	1036,15±36,14
	A.E fraction	1673,99±206,03	NT	1001,42±20,06	966,69±40,10	1013,00±20,06
DPPH (µmol (AAE)/g)	Methanolic extract	777,97±10,33	709,82±7,67	735,38±11,14	197,44±19,18	788,13±14,75
	DCM fraction	262,98±4,43	505,57±10,22	36,65±19,88	148,10±2,56	634,92±5,90
	A.E fraction	818,76±3,87	NT	603,45±8,94	371,10±5,32	640,80±2,56
ABTS (µmol (AAE)/g)	Methanolic extract	13437,82±83,11	13101,46±83,27	10745,60±144,24	9543,63±231,83	17452,58±249,82
	DCM fraction	11034,07±472,91	10793,68±41,64	10120,58±890,11	10096,54±124,91	12548,55±504,83
	A.E fraction	14255,35±166,55	NT	9976,34±83,27	7235,85±83,27	9062,84±434,71

Data are Mean ± SEM (n=3), NT: Not Tested.

The antioxidant activity by the ABTS method expressed in mmol ascorbic acid equivalent per gram (mmol EAA/g) of extract presented in Table 2 reveals for the methanolic extracts that the extract of *T. macroptera* is more reducing of the ABTS radical with 17452.58±249.82 mmol EAA/g, while the methanolic extract of *S. latifolia* is the least reducing of this radical (9543.63±231.83 mmol EAA/g). The DCM fraction of *E. africana* and *S. latifolia* are reducers of the ABTS radical with respective close values of 10120.58±890.11 mmol EAA/g and 10096.54±124.91 mmol EAA/g respectively which are however less than that of *T. macroptera* which exhibits the best activity (12548.55±504.83 mmol EAA/g) for this fraction. As for the ethyl acetate fraction, a comparative study of extracts from five plants reveals that the fraction of *C.*

*sieberiana* is the most reducing of the ABTS radical while that of *S. latifolia* is the least effective. Of all the extracts tested and fractions, the methanolic extract of *T. macroptera* was found to be the best in terms of reduction of the ABTS radical.

### 3.4. Prostate cancer cells 22RV1 proliferation inhibition Activities



**Figure 4** Methanolic extracts toxicity on prostate cells 22RV1

- *S. latifolius* IC<sub>50</sub>: 359.1 µg/mL (tested concentrations range from 296.9 to 434.3)
- *T. macroptera* IC<sub>50</sub>: 242.3 µg/mL (tested concentrations range from 210.3 to 279.1)
- *E. africana* IC<sub>50</sub>: 48.34 µg/mL (tested concentrations range from 39.33 to 67.20)
- *Cassia sieberiana* IC<sub>50</sub>: 48.34 µg/mL (tested concentrations range from 39.33 to 67.20) and
- *C. planchonii* IC<sub>50</sub>: 133.7 µg/mL (tested concentrations range from 111.2 to 160.8)

Different concentrations of *S. latifolius*, *T. macroptera*, *E. africana*, *C. planchonii*, *C. sieberiana* methanolic extracts were tested to determine their cytotoxicity on prostate cancer cells 22RV1 and the results are presented respectively in Figure 4. Nine concentrations of extracts from each plant species, ranging from 0 to 500 µg/mL, were tested on the prostate cancer cell line. The first concentration was control (0 µg/mL). Five graphs were obtained: Figure 4a (tested concentrations range from 296.9 to 434.3), Figure 4b (tested concentrations range from 210.3 to 279.1), Figure 4c (tested concentrations range from 39.33 to 67.20), Figure 4d (tested concentrations range from 39.33 to 67.20) and Figure 4e (tested concentrations range from 111.2 to 160.8). Values expressed as the concentration of extract that inhibits the 50% of the proliferation of cancer cells tested (IC<sub>50</sub>) were ranged from 48.34 µg/mL to 359.1 µg/mL. *E. africana* were found to be the most toxic prostate cancer cells 22RV1. Other researchers, such as Badiaga [16], obtained an IC<sub>50</sub> of 42.37 0.31 µg/mL by evaluating the antiproliferative capacity of *T. macroptera*, methanolic extract on prostate cancer PC3 cells using flow cytometry. Similarly, Tagne et al. [17] showed that total alkaloid extracts from *S.*

latifolius bark and roots were active on MCF-7 breast cancer cells with IC50 ranging from 12 to 39 µg/mL. Many reactive species are known to be implicated in the process of oxidative stress, inflammation and cancers [18]. Hydroxyl radical (OH•) which is one of the most powerful and the most prominent radical found in vivo is formed by the reaction of reactive oxygen radicals (O<sub>2</sub>) with hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) in the presence of Fe<sup>2+</sup> or Cu<sup>+</sup> as a catalyst. The antioxidant potential of the tested extract may then explain the potential of inhibiting cancer cell proliferation.

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#### 4. Conclusion

This study was designed to collect information on the medicinal plants preconized by the traditional health practitioners of Bobo Dioulasso and evaluate the total phenolics and flavonoids content before assessing the antioxidant and anticancer potential of the selected plant. A total of 22 plants cited as being used in traditional treatment against malaria 5 had the highest citation frequencies. They presented significant content of total phenolics and total flavonoids. *T. macroptera* was the richness in phenolic content and was found to possess the best antioxidant potential while *E. africana* were the poorest in phenolic content, however, it showed the best cytotoxic activity. Cytotoxicity of the selected plant may be in relation to other class of metabolites different from those of polyphenols. The different results obtained on phenolic, flavonoid contents may justify the use of the tested plant in the treatment of malaria. The cytotoxicity of *E. africana* on prostate cancer cells 22RV1 will serve further in the investigation for research of other class of molecules and their isolation.

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#### Compliance with ethical standards

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##### Disclosure of conflict of interest

The authors declare no conflict of interest.

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