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In vitro antisalmonella and antioxidant effects of various extracts from leaves and stem of *Tristemma mauritianum* (Melastomataceae).

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ABSTRACT

Typhoid fever and others salmonellosis are always a marked problem of public health in developing countries. The most affected continents are Africa and Asia. Since the causative agents rapidly become resistant to the usual antibiotics, this work aimed to evaluate *in vitro* the potential of *Tristemma mauritianum* extracts against *Salmonella* sp bacteria and theirs antioxidant activity. The methanol and various hydroethanol extracts of *Tristemma mauritianum* were tested for *in vitro* antisalmonella activity using broth microdilution technique. The antioxidant activity was evaluated for the scavenger of DPPH and Nitric Oxide whereas the ability to reduce ferric ion was carried out using TPTZ. Finally the total phenolic content and the total flavonoids content were estimated. Among crude extracts, the methanol extract and the 75% ethanol extract showed the best *in vitro* activity with MICs varying from 48 to 192 µg/ml. Nevertheless, this activity was less than that exerted by the reference drugs. The antioxidant ability of extracts showed that, many extracts inhibit DPPH and NO more than the references (Buthylhydroxytoluene and ascorbic acid). They also significantly reduced the ferric ion and possessed important quantities of phenols and flavonoids.

Keywords: Antisalmonella, antioxidant, *Tristemma mauritianum*, typhoid fever

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INTRODUCTION

Despite the multiple usages of antibiotics and the most advance research and the development of new products, typhoid and paratyphoid remain an important problem in development countries. In 2004, World Health Organization (WHO) estimated as 22 million of cases and 216 500 deaths each year. In 2008, vaccination program was systematically introduced in several parts of Asia by WHO [1]. Actually, typhoid and paratyphoid fevers remain an important problem of public health particularly in Asia and in sub-Saharan Africa [2-6]. *Salmonella* sps are Gram-negative facultative intracellular bacteria which causes typhoid. Contaminations with *Salmonella* occur after ingestion of bacteria in contaminated water, food and close contact with an infected person or carrier. Typhoid and paratyphoid fevers manifest one or two weeks follows infection and the most clinical signs are fever and malaise, abdominal pain and be associated or not with headache, myalgias, nausea, anorexia, constipations and occasionally diarrhoea [7]. Typhoid and paratyphoid fevers were easily managed using common antibiotics such as ampicillin, chloramphenicol and cotrimoxazole [8]. Due to the adaptation of organism adding of the non-respectful of medical prescription and the uncontrolled use of antibiotics, bacteria of *Salmonella* genus rapidly gained resistance to common antibiotics including the third generation of quinolones [9,10].

Additionally, when typhoid fever occurs, Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS) are produced by the cells of human innate immunity to destroy bacteria. In fact, after detection of pathogen-associated molecular patterns (PAMPs) through the NADPH oxidase complex, macrophages and neutrophils generate ROS whereas inducible nitric oxide synthase (iNOS), produce RNS through the conversion of L-arginine and oxygen [11]. Some bacteria like those from *Salmonella* genus have at least two ways to growth and disseminate in the conditions of stress induced by the generation of ROS and RNS. The first partway is to produce enzymes (catalase, superoxide dismutase, peroxidases and DNA repair enzymes) which convert free radicals into non toxic molecules. The second partway is the expression of *Oxy-R* gene which produced many proteins allowing them to resist against to free radicals destruction [12,13]. The increase of free radicals production may induce oxidative stress conditions which can cause the alteration of biological molecules associated to severe damages or degenerative diseases [14]. For aforesaid reasons, many researchers focuse theirs work on the discovering of the antibacterial compounds with free radical scavenger potential. This approach may allow developing at time compounds able to inhibit the growth of bacteria and reduce the stress conditions which may occur during *Salmonella* infections. Due to the diversity and richness in bioactive metabolites with enormous pharmacological potentials including antibacterial and antioxidant, medicinal plants appear as one of the candidate of such study [15-21]. Many plants are using in Cameroon for the management of typhoid fevers and associated symptoms. Among of these plants, *Tristemma mauritianum* (Melastomataceae), in association with others is widely used in the west part of the country for the treatment of haemorrhoid, some reproductive problems and typhoid fever. It is an herb or small bush of 1.25 m high, which growths in marshy and moist places from Senegal to west Cameroon and Equatorial Guinea, and extending to Congo (Brazzaville) and upper Shari [22]. The fleshly fruits are eating. Our study was aimed to evaluate the antisalmonella and antioxidant potential of various extracts of the stem and leaves of *Tristemma mauritianum*.

MATERIALS AND METHODS

Plant material

The stem and leaves of *Tristemma mauritianum* were collected in Fongo-Tongo, West region, Cameroon, in October 2014. The authentification was carried out at the Cameroon National Herbarium (Yaoundé) in comparison to the specimen register under the reference 5895 SRF/Cam.

Preparation of plant extracts

After drying the different parts of *Tristemma mauritianum,* the powder (60 g) was macerated in each solvent for 48 h and filtered using wattman paper N°1. The obtained filtrates were concentrated at 45 °C in oven to obtain of aqueous crude extract, various hydroethanol extracts (75:25, 50:50, 25:75) and ethanol extract. Those extracts were keep in the freezer (-4 °C) for further use. To obtain the methanol extract, the filtrate was concentrated under reduction pressure using the rotavapor (R-200) and dried completely at 45 °C into an oven.

Chemicals and reagents

Ciprofloxacin (Sigma-Aldrich), oxytetracyclin (Pantex) were used as reference antibiotics whereas p-iodonitrotetrazolium chloride (INT) was used as bacterial growth indicator. Diphenylpicrylhydrazine (DPPH), Sodium nitroprusside, sulphanilamide, N-1-napthylethylenediamine dihydrochloride, ascorbic acid, Buthylhydroytoluene (BHT), 2,4,6-Tri (2-pyridyl)-s-triazine (TPTZ), ferric chloride were used for the antioxidant assay. Folin-Ciocalteu reagent, sodium carbonate, Gallic acid, aluminium chloride, $NaNO_2$, sodium hydroxide and catechin were used to evaluate the total phenolic content and the total flavonoids content.

Bacteria used and culture media

Microorganisms used for antimicrobial activities included four isolates namely *Salmonella* Typhi, *Salmonella* Paratyphi A, *Salmonella* Paratyphi B and *Salmonella* Typhimurium. These isolates were obtained from the Medical Bacteriology Laboratory of the *Centre Pasteur*, Yaoundé, Cameroon. One reference strain *Salmonella* Typhi ATCC6539 obtained from American Type Culture Collection was used as reference strain. Salmonella Shigella Agar (SSA) was used for the activation of isolates whereas Mueller Hinton Broth (MHB) was used for *in vitro* antibacterial assay.

***In vitro* antisalmonella assay**

Minimal Inhibitory Concentrations (MIC) and Minimal Bactericidal Concentrations (MBC) of the plant extracts and reference antibiotics were determined by microdilution method using rapid INT colorimetric assay [23]. Briefly, extracts were dissolved in 5% Dimethyl-sulfoxide (DMSO)/Mueller Hinton Broth (MHB). The microplates were prepared by introducing into each well 100 µl of MHB to which the tested substances were added and two fold serially diluted in a 96-well microplate. One hundred microliters of inoculum (1.5×10^6 cfu/ml) prepared in MHB were then added. The plates were covered with a sterile plate sealer and incubated at 37 °C for 18 h. The final concentration of DMSO was 2.5%, and did not affect the bacterial growth. Wells containing MHB, 100 µl of inoculum, and DMSO at a final concentration of 2.5% served as the negative control. The MIC of each sample was determined after 18 h of incubation at 37 °C following addition of 40 µl INT (0.2 mg/ml) and incubation at 37 °C for 30 min. Viable bacteria reduced the yellow dye into a pink. The MIC was defined as the lowest concentration that prevented this change of coloration. The MBC of the sample was determined by sub-culturing 50 µl of the suspensions from the wells which did not show any growth after incubation during MIC assays in 150 µl of fresh broth, and re-incubated at 37 °C for 48 h before revelation. The MBC was defined as the lowest concentration of sample which completely inhibited the growth of bacteria. Each assay was performed in triplicate.

Evaluation of the antioxidant potential

DPPH scavenging activity

The radical scavenging activity of extracts of *T. mauritianum* was determined spectrophotometrically at 517 nm using DPPH radical [24]. Extracts and Buthylhydroytoluene (BHT) were prepared in methanol and tested at concentration ranging from 12.5 to 200 µg/ml. A volume of 900 µl of DPPH° solution (20 mg/l) was mixed with 100 µl of test sample. All have been incubated at room temperature in dark for 30 minutes and the absorbances (Ab) were read. The experiments were carried out in triplicate for each concentration. The percentages of DPPH° scavenged (RSa %) by test samples were calculated as:

$$RSa\ (\%) = \frac{Ab - As}{Ab} \times 100$$

Where Ab is the absorbance of the DPPH alone and As the absorbance of the mixture.

Ferric reducing antioxidant power (FRAP) assay

The ferric reducing antioxidant power of each extract was determined using the method described previously [25]. The FRAP reagent was prepared with ten parts of acetate buffer (300 mM, pH 3.6), one part of

2,4,6-Tri (2-pyridyl)-s-triazine (TPTZ) (10 mM in 400 mM of HCl), and one part of ferric chloride (10 mM). Each extract (75 µl) was transferred into a cuvette containing 2 ml of FRAP solution and after agitation absorbance was read at 593 nm after 12 minutes of incubation. The ferric reducing antioxidant power of each extract was determined as milligram of ascorbic acid equivalent by linear interpolation of an ascorbic acid standard curve.

Nitric oxide radical scavenging activity

Nitric oxide generated from sodium nitroprusside in aqueous solution at physiological pH interacts with oxygen to produce nitrite ions, which was measured using the Griess reaction [26]. Brefly, in 750 µl of sodium nitroprusside, 500 µl of extract or ascorbic acid (reference) was added at different concentration (12.5, 25, 50, 100 and 200 µg/ml). The mixture was then incubated at room temperature for 120 min. The blank was done by replacing extract with methanol. At the end of the incubation time, 1.25 ml of Griess reagent (1% sulfanilamide in 5% phosphoric acid and 0.1% N-1-napthylethylenediamine dihydrochloride in water) was added and the absorbance was recorded after 5 min (darkness) at 540 nm. Inhibition percentages of the nitrite oxide generated were measured by comparing the absorbance values of control and test samples.

Evaluation of total phenolic contents

The total phenolic content (TPC) in extracts was estimated using the Folin-Ciocalteu reagent (FCR) as described in the litterature [27]. The reaction mixture contained 20 µl of extract (1 mg/ml), 1380 µl of distilled water, 200 µl of 2N FCR and 400 µl of sodium carbonate solution (20%). The mixture was incubated during 20 min at 40 °C. After cooling, the absorbance was recorded at 765 nm. The blank was prepared with distilled water instead of plant extracts. The standard curve was plotted using Gallic acid (0-0.2 mg/ml) and each test was performed in triplicate. The results were expressed as milligrams of Gallic Acid Equivalents (mgGAE) per gram of extract.

Evaluation of total flavonoids contents

Total flavonoids content (TFC) was evaluated using the aluminium chloride. Briefly, 100 µl of extract (2 mg/ml) were mixed with 1.49 ml of distilled water and 30 µl of $NaNO_2$ (5%). After 5 min at room temperature, 30 µl of $AlCl_3$ (10%) was added and reincubated for 6 min before adding 200 µl of sodium hydroxide (0.1 M) and 240 µl of distilled water. The solution was mixed and the absorbance was recorded at 510 nm and converted into milligrams of Equivalents Catechin (mgECat) per gram of extract using the catechin standard calibration curve.

Statistical analysis

The data are expressed as mean value ± standard deviation (SD) of different replicates. The comparison was subjected to One-Way Analysis of Variance (ANOVA), and the significant differences between means at $P<0.05$ were determined by Waller-Duncan test using the Statistical Package for the Social Sciences (SPSS) software version 16.0.

RESULTS

Antisalmonella activity

The Table 1 presents the inhibitions parameters of various extracts of *Tristemma mauritianum* on different *Salmonella* bacteria. These results are variable depending on extract and the bacterium. All those extracts inhibited the growth of *Salmonella* with MICs varying from 48 to 1536 µg/ml. Some extracts presented interesting values of MICs sometime less than 100 µg/ml. The methanol extract and the ethanol 75% extract of leaves presented the best inhibitory parameters. They inhibited two and three tested bacteria respectively for the methanol extract and 75% ethanol extract with MICs lower than 100 µg/ml. The lowest MIC was obtained with ethanol 100% and ethanol 75% leaves extracts on *Salmonella* Paratyphi A. The aqueous extract of leaves presented the lower antisalmonella potential. Most of the extracts presented the ratio MBC/MIC equal or low than 4. The extracts of leaves were more interesting than those of the stem tested. All those inhibition parameters remain less active compare to the references (ciprofloxacin and oxytetracyclin).

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Table 1: Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal Concentration (MBC) of various extracts of *Tristemma mauritianum* on *Salmonella* bacteria.

Extracts	Parameters	SPA	SPB	ST	STM	ST ATCC6539
Methanol leaf extract	MIC	**192**	**96**	**96**	**192**	**192**
	MBC	**1536**	**96**	**384**	**768**	**768**
	MBC/MIC	**8**	**1**	**4**	**4**	**4**
Ethanol leaf extract 100%	MIC	48	768	192	786	768
	MBC	192	1536	384	1536	1536
	MBC/MIC	4	2	2	2	2
Ethanol leaf extract 75%	MIC	**48**	**96**	**192**	**96**	**192**
	MBC	**96**	**192**	**192**	**384**	**384**
	MBC/MIC	**2**	**2**	**1**	**4**	**2**
Ethanol leaf extract 50%	MIC	192	96	96	1536	-
	MBC	384	384	768	1536	-
	MBC/MIC	2	4	8	1	/
Ethanol leaf extract 25%	MIC	384	384	96	-	384
	MBC	384	768	384	-	1536
	MBC/MIC	1	2	4	/	4
Aqueous leaf extract	MIC	768	384	768	-	384
	MBC	768	-	1536	-	-
	MBC/MIC	1	/	2	/	/
Ethanol stem extract 100%	MIC	192	384	384	768	768
	MBC	768	768	768	1536	768
	MBC/MIC	4	2	2	2	1
Ethanol stem extract 50%	MIC	96	768	192	384	192
	MBC	768	768	384	1536	768
	MBC/MIC	8	1	2	4	4
Ciprofloxacin	MIC	0.1875	0.375	0.375	0.375	0.375
	MBC	0.375	0.375	0.75	0.75	0.375
	MBC/MIC	2	1	2	2	1
Oxytetracyclin	MIC	2	4	4	8	8
	MBC	16	16	32	32	32
	MBC/MIC	8	4	8	4	4

SPA: *Salmonella* Paratyphi A, SPB: *Salmonella* Paratyphi B, ST: *Salmonella* Typhi, STM: *Salmonella* Typhimurium, -: more than 1536 µg/ml, /: non determined.

Antioxidant potential

DPPH radical scavenging activity

The capacity of plant extracts and BHT (reference) to inhibit the DPPH radical is presented in the Table 2. Generally, all those extracts possess an important activity against the DPPH radical. The most actives extracts are the methanol leaves extract and the ethanol stem extract which inhibit more than 90% of DPPH radical at the concentration of 12.5 µg/ml. Apart for the aqueous leaf extract, all the extracts significantly ($p<0.5$) inhibited the DPPH more than BHT at all the tested concentrations.

Table 2: Free radical scavenging activity of various extracts of Tristemma mauritianum against DPPH radical.

Extracts	Concentration (µg/ml) and DPPH scavenging activity (%)				
	12.5	25	50	100	200
Methanol leaf extract	91.23±0.516^{g}	92.40±0.195^{d}	93.37±0.39^{b}	94.61±0.406^{c}	95.58±0.406^{c}
Ethanol leaf extract	81.32±1.964^{e}	94.01±0.244^{de}	95.49±0.122^{c}	95.84±0.122^{de}	96.76±0.122^{d}
Ethanol 75% leaf extract	70.54±0.999^{c}	93.73±0.440^{de}	94.86±0.122^{c}	95.28±0.244^{cd}	96.19±0.211^{cd}
Ethanol 50% leaf extract	75.97±2.097^{d}	94.24±0.120^{e}	95.56±0.318^{c}	96.25±0.208^{de}	96.81±0.241^{d}
Ethanol 25% leaf extract	74.72±1.387^{d}	81.25±0.751^{c}	95.14±0.318^{c}	95.69±0.12^{de}	96.11±0.12^{c}
Aqueous leaf extract	40.25±0.694^{a}	58.83±1.95^{a}	85.51±0.604^{a}	92.09±1.202^{b}	94.80±0.228^{b}
Ethanol stem extract	86.89±1.014^{f}	94.93±0.114^{e}	95.32±0.114^{c}	95.59±0.114^{cde}	96.05±0.198^{c}
Ethanol 50% stem extract	91.23±0.703^{g}	94.35±0.39^{e}	95.71±0.195^{c}	96.36±0.298^{e}	98.12±0.596^{e}
BHT (ref)	56.51±0.980^{b}	78.46±1.518^{b}	85.62±1.032^{a}	90.85±0.704^{a}	94.13±0.407^{a}

In each column, values with the same letter are not statistically different at 95% using Waller-Duncan test.

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NO radical scavenging activity

The Table 3 summarizes the capacity of extracts to inhibit the nitrogen oxide radical. The data obtained from this test (Table 3) show that all the extracts are able to inhibit the NO radical. This inhibitory potential varies from one extract to another. The most active extract is the ethanol 100% extract of stem follow by the ethanol 75% extract of leaves whereas the less active were the aqueous extract of leaves and the 50% ethanol extract of stem. At the higher concentration (200 µg/ml), the 75% ethanol extract of leaves and the 100% ethanol extract of stem significantly ($p<0.5$) inhibit the NO more than the ascorbic acid (reference).

Table 3: Free radical scavenging activity of various extracts of *Tristemma mauritianum* against NO radical.

Extracts	Concentration (µg/ml) of samples and NO scavenging activity (%)				
	12.5	25	50	100	200
Methanol leaf extract	12.74±1.558^{ab}	28.404±2.276^{bc}	37.81±1.042^{a}	52.22±0.84^{a}	65.93±0.232^{b}
Ethanol leaf extract	15.73±1.916^{b}	32.547±3.567^{c}	50.41±1.294^{cd}	55.11±0.926^{b}	70.35±0.75^{c}
Ethanol 75% leaf extract	27.52±1.416^{c}	37.298±2.448^{d}	49.09±1.217^{c}	61.25±1.939^{c}	73.27±1.432^{d}
Ethanol 50% leaf extract	28.33±3.596^{c}	37.772±2.053^{d}	49.25±0.948^{c}	56.14±0.902^{b}	69.41±0.25^{c}
Ethanol 25% leaf extract	8.55±0.843^{a}	23.622±2.104^{a}	42.53±2.779^{b}	49.85±0.677^{a}	59.57±0.287^{a}
Aqueous leaf extract	13.14±2.717^{ab}	31.033±1.282^{bc}	42.58±1.828^{b}	52.06±1.722^{a}	69.17±0.833^{c}
Ethanol stem extract	35.69±1.495^{d}	53.519±0.958^{e}	61.79±1.478^{e}	65.10±0.325^{d}	74.17±0.068^{d}
Ethanol 50% stem extract	11.77±3.462^{ab}	27.795±2.379^{ab}	44.64±1.405^{b}	49.97±1.547^{a}	59.56±1.045^{a}
Ascorbic acid	38.99±2.501^{d}	49.252±0.687^{e}	53.37±1.564^{d}	62.64±1.229^{cd}	70.52±0.232^{c}

In each column, values with the same letter are not statistically different at 95% using Waller-Duncan test.

Ferric Reducing activity (FRAP)

The Table 4 presents the ferric reducing ability of various extracts of *Tristemma mauritianum*. All of the tested extracts reduced iron but differently. The most important activity was recorded with the 100% ethanol extract of leaves but was not statistically different ($p\geq0.5$) from those obtained with the methanol extract, the 75% ethanol extract and the 50% ethanol extract. The most statistically lower activity was obtained with the 50% ethanol extract of stem.

Table 4: Total phenolic content (TPC), Total Flavonoids Content (TFC) and Ferrique reduction ability of various extracts of *T. Mauritianum.*

Extracts	TPC (mgEGA/g of extract)	TFC (mgECAT/mg of extract)	FRAP (mgEAA/g of extract)
Methanol leaf extract	426.5±0.347^{ab}	1.64±0.19^{b}	310.2±0.103^{b}
Ethanol leaf extract	432.6±1.906^{b}	1.82±0.23^{b}	315.1±0.819^{b}
Ethanol 75% leaf extract	408.3±1.074^{a}	1.62±0.089^{ab}	311.8±0.291^{b}
Ethanol 50% leaf extract	416.7±0.473^{ab}	1.43±0.289^{ab}	305.7±0.084^{b}
Ethanol 25% leaf extract	418.9±0.731^{ab}	1.66±0.257^{b}	nd
Aqueous leaf extract	406.1±1.074^{a}	1.22±0.201^{a}	nd
Ethanol stem extract	409.8±1.074^{ab}	1.69±0.161^{b}	nd
Ethanol 50% stem extract	406.1±1.389^{a}	1.74±0.015^{b}	84.3±2.128^{a}

nd: non determined. In each column, values with the same letter are not statistically different at 95% using Waller-Duncan test.

Total phenolic and flavonoids contents

The analysis of total TPC and TFC revealed that most of those types of metabolites are present in each extracts of *Tristemma mauritianum*. The TPC and TFC were significantly ($p<0.5$) high in 100% ethanol extract of

leaves, fellowed by the methanol extract of leaves for the TPC and the 50% ethanol extract of stem. The aqueous extract had the loweest values of TPC and TFC.

DISCUSSION

The antibacterial test showed MIC varying from 48 to 1536 µg/ml against five bacteria of *Salmonella* genus. Based on the cut-off values of the MICs proposed by the literature, the antimicrobial potential of crude extracts are classified as significant when MIC < 100 µg/ml; moderate, when 100 ≤ MIC≤ 625 µg/ml; and low, when MIC> 625 µg/ml [17]. According to that classification, methanol extract, ethanol (100%, 75% and 50%) extracts of the leaves of *T. mauritianum* presented significantly activities against some of the tested bacteria. The 50% ethanol extract of the stem also inhibited significantly SPA. The most active extract (75% ethanol extract of leaves) inhibited significantly three of the bacteria tested. According to the criteria used by Gatsing and Adoga, the antibacterial substances is considering as bactericidal, when MBC/MIC ≤ 4 and bacteriostatic, when MBC/MIC > 4 [28]. Based on those criteria, the large majority of these extracts are bactericidal. Enormous varieties of phenols including flavonoids from Cameroonian medicinal plants are known for their antibacterial properties [29-32]. In addition, much plant extracts and isolated compounds from the Melastomataceae family had been presented to possess antibacterial activity [33-36].

Multiple mechanisms are involved in the initiation of the oxidative stress. So a single method is not sufficient to conclude about the antioxidant property of one sample [37]. That is why in this study, we used more than two assays to assess the ability of the studied extracts to scavenge free radicals (DPPH and NO) and it reducing power. The DPPH is a stable radical which absorbs the light at 517 nm and losses that ability when receiving electron or proton. The reduction of DPPH observed in this experiment must be due to the ability of compounds presents of the studied extracts to donate the proton to the DPPH radical. Except the leaf aqueous extract, all the extracts significantly inhibited DPPH than the BHT used as reference. This result is highly supported by the quantity of TPC and TFC presented found in those extracts. In addition, many extracts and compounds isolated from plants of the melastomataceae family have been shown to inhibit the DPPH radical [34,35,38,39]. The Nitric Oxide (NO) is normally produced by the normal system for many biological activities like smooth muscle relaxation, neuronal messenger, vasodilation and antimicrobial and anti-tumour activities [20,37]. The NO can also be combined to oxygen to produce nitrate and nitrite which are associated with the nitration of proteins and the activation of kinases [14]. The increase of NO scavenging percentage may be due to the bioactives molecules present in those extracts like ethanol extracts. These results are in correlation which those observed by Nono *et al* with extracts and compounds from *Dissotis thollonii*, the plants of melastomataceae family [35]. The ferric reducing capacity of some of those extracts was also evaluated. In the physiology of living organism, the interaction between ferric ion and superoxide anion induces the formation of hydroxyl radical which could initiate the oxidation of DNA, lipids peroxidation, oxidation of proteins and the activation of kinases [14]. So, the reduction of ferric ion can prevent those damages. The results obtained in this study showed that except 50% ethanol extract of stem, all the tested extracts significantly reduced the ferric ion. Other plant extracts belonging to the same family has been highlighted for their ferric reducing ability [35,40].

Generally, the most active extracts; ethanol 75%, methanol and ethanol extracts of leaves and the two extracts of stem, also had high level of TPC and TFC. For the ferric reducing capacity, the high TPC produced of leaf ethanol extract produced the highest reducing capacity and may fortify these results. The quality of compounds and the high content of phenols and flavonoids may then be responsible for these activities. In addition, many phenolics compounds including flavonoids had already been isolated from the plants of Melastomataceae family and presented antibacterial and antioxidant properties [34-36].

CONCLUSION

These results showed that the methanol and various hydroethanol extracts of leaves and stem of *T. mauritianum* possess an interesting *in vitro* antisalmonella and antioxidant potentials. They may then be used to manage typhoid and associated stress conditions. Nevertheless, many investigations are needed to complete this work and to well understand the variability of these activities.

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