Upgrading the Medicinal Value Chain of Neglected and Underutilized *Eremomastax* (Lindau.) species through Antioxidant Health Benefits

Edak Aniedi UYOH*, Peter N. CHUKWURAH, Ikootobong S. URUA, Helen M. UMOFFIA

*Corresponding author: Tel., +2348037929022.

**Article History:** Received 30 July 2013, Revised 23 September 2013, Accepted 25 September 2013.

**Abstract:** A critical step towards improvement of global health care delivery system lies in the discovery and optimal utilization of the wide range of medicinal plant resources available in nature. Against this backdrop, the antioxidant potential of two underutilized crops – *Eremomastax speciosa* (Hochst.) Cufod. and *Eremomastax polysperma* (Benth.) Dandy, growing under lowland humid tropical conditions of southern Nigeria were investigated using selected complementary *in vitro* assay systems. Ascorbic acid, Gallic acid and Na₂EDTA were used as standard reference compounds and the plants’ leaves were extracted using 80% ethanol. Extracts of the two species contained good levels of antioxidant metabolites (36.44 – 57.56 µg Gallic Acid Equivalents/mg, and 67.83 – 141.58 µg Rutin Equivalents/mg for total phenol and flavonoid contents respectively). The extracts scavenged 50% (IC₅₀) of stable DPPH and hydroxyl radicals at 89.14µg/ml and 40.76µg/ml; 30.23 mg/ml and 23.18mg/ml respectively. The extracts further chelated 50% of iron II ions (Fe²⁺) at 1.14mg/ml and 1.21mg/ml respectively. Results of the reducing power assay and total antioxidant capacity indicated that the extracts were potent in electron donation, thus were capable of reducing Fe³⁺ and Mo (VI) ions to their lower oxidation states. *E. polysperma* generally showed superiority (p<0.05) to *E. speciosa* in the entire test assays. The results obtained is a significant pointer to the potential health benefits of these underutilized plants to humans and animals as antioxidants that could provide natural mitigation to the hazardous effect of free radicals, hence the need to upgrade their medicinal value chain.

**Keywords:** Antioxidant; *Eremomastax* species; under-utilized species; free radical.

**Introduction**

In nature, numerous medicinal plant species abound and ultimately constitute the primary source of important life-saving drugs for humanity (Khan et al. 2009). The medicinal benefits of many of these plants have already been scientifically established and exploited, but it is also common knowledge that majority of our vast natural plant resources, especially those utilized in traditional healthcare, are still neglected and under-studied. The unfortunate implication of this is that undue limitation may be placed on the scope of available and exploitable raw material needed for achievement of improved health care delivery globally. In Nigeria, *Eremomastax speciosa* and *E. polysperma*, locally known as “ikpo ikong” and “edem iduduo” respectively in both Efik and Ibibio speaking tribes of Cross River and Akwa Ibom states of Nigeria represent some of such neglected and under-utilized species. The plants are erect, multi-branched tropical herbs belonging to the Acanthaceae family. *Eremomastax speciosa* is used locally in southern Nigeria for the treatment of infertility (Mboso et al. 2013a), while *Eremomastax polysperma* commonly called the blood tonic plant, is used in the treatment of diabetes, anaemia, and internal heat (Pandey 2006).

Much as these plants are highly valued by the natives, knowledge on their use as herbal remedies is simply passed orally from previous generations. There is thus, a general paucity of documented scientific literature on their wide range of medicinal values. Worthy of note however, is that the few available reports are encouraging. Phytochemical screening of the plants’ leaves revealed the presence of tannins, phenols, flavonoids, alkaloids, sapoines and terpenes (Mboso et al. 2013a). Ethanolic extract of *E. speciosa* showed no toxic effect on the serum levels of female hormonal system in pubertal rats (Mboso et al. 2013b). Significant antimicrobial and antiaenaemic activities of different...
extracts of *E. speciosa* have been reported (Okokon et al. 2007) and its aqueous extract have been shown to significantly reduce castor oil-induced diarrhea in experimental animals (Oben et al. 2006). Leaf aqueous extract of *E. speciosa* also inhibited HCl/EtOH and pylorus ligation-induced gastric ulceration in rats, dose dependently (Tan et al. 1996).

The medicinal potentials of *Eremomastax* species are far from being fully studied and one of such limiting areas is their antioxidant benefits. Antioxidants are compounds that can delay or inhibit the oxidation of lipid or other biological molecules by inhibiting the initiation or propagation of oxidizing chain reactions (Velioglu et al. 1998). These reactions, perpetuated by free radicals in their quest for stable electronic configuration, cause a myriad of oxidative damages including ageing, cancer, degenerative and cardiovascular diseases (Tripathy et al. 2010). Plants are reservoirs of active natural compounds including vitamins, phenols, carotenoids and flavonoids which function as potent antioxidants (Aiyeogoro and Okoh 2010); such antioxidants usually act as a second line defense mechanism against oxidative stress *in vivo* especially through their radical scavenging activities (Niki 2010). Other important mechanisms through which plant-derived antioxidants exert antioxidant influence are quenching of singlet and triplet oxygen, decomposition of peroxides and synergism (Wang 2003). Interestingly, studies have proven that even some under-utilized plant species have significant antioxidant levels. In Nigeria, for example, the need for increased domestication of two under-studied spices – *Ocimum basilicum* and *Ocimum gratissimum* have been justified by their appreciable levels of antioxidant activity (Uyoh et al. 2013a). In a related study, a case was also made for the nutritional relevance of *Piper nigrum* and *Monodora myristica* due to their antioxidant benefits that cannot be ignored (Uyoh et al. 2013b).

The antioxidant activities of *Eremomastax speciosa* and *Eremomastax polysperma*, to the best of our knowledge, have not been presented in literature. Considering its imperativeness, this study was carried out to evaluate the antioxidant activities of ethanolic extracts of the two species in complementary *in vitro* assay systems, as a preliminary step in understanding their potential usefulness in this regard.

**Materials and methods**

**Collection and Extraction of Plant Material**

Fresh leaves of *Eremomastax speciosa* and *Eremomastax polysperma* (Figure 1) were collected from their natural growing environment in Calabar South Local Government Area, Calabar (located at 4º59 36ˈ N, 8º19 05ˈ E), Cross River State, Nigeria. Authentication of identity of the plants was done by the plant taxonomist in Botany Department, University of Calabar, Nigeria. The leaves were freed from debris, dried at room temperature and milled separately. Twenty grams of each milled sample was extracted by soaking in 300ml of 80% ethanol for 72h at room temperature. The soaked samples were shaken intermittently during the extraction period and subsequently filtered using Whatman No. 1 filter paper. The resulting extracts were concentrated under vacuum in a rotary evaporator at 45ºC for complete solvent removal. A stock solution (5000µg/ml) of each crude extract was prepared and desired working concentrations were made by appropriate dilutions.

**Chemicals**

DPPH (1, 1-diphenyl-2-picryl hydrazyl) radical, Ferrozine and Rutin were purchased from Sigma-Aldrich Chemical Company, St. Louis, MO, USA; Folin and Ciocalteau’s reagent and Trichloroacetic acid (TCA) from Qualikems Fine Chemical Pvt. Ltd., New Delhi, India; Gallic acid monohydrate from Kem Light Lab. Pvt. Ltd., Mumbai, India. Solvents and other chemicals used for this study were of analytical grade, while water was glass distilled.

**Determination of extract yield (%)**

The percentage yield of extract from each plant sample was obtained by dividing the weight of the concentrated crude extract by that of initial weight (20g) of dry milled starting material and multiplying the ratio by 100.
Figure 1: Shoot and whole plant of *Eremomastax speciosa* and *Eremomastax polysperma* respectively. a. *Eremomastax speciosa* (x ½), b. *Eremomastax polysperma* (x ½).

**Determination of Total Phenol Content (TPC)**

The total phenol contents of the extracts were determined by the Folin-Ciocalteau method (Duarte-Almeida et al. 2006). Briefly, to 500µl of each extract solution (1000µg/ml) was added 100µl of Folin Ciocalteau reagent and 6ml of distilled water, then shaken for one minute. Thereafter, 2 ml of 15% sodium carbonate was added to the mixture and shaken again for 30 sec. Finally, the solution was brought up to 10 ml by adding distilled water. The absorbance at 750nm was measured after 1.5h incubation at room temperature using a spectrophotometer (LABTECH UV/VIS, India). Gallic acid monohydrate, a standard phenol, in the range of 5 - 40 µg/ml was used to prepare a standard reference curve. The total phenol contents (TPC) of the extracts were expressed as Gallic Acid Equivalents (GAE) from the linear regression curve of Gallic acid.

**Determination of Total Flavonoid Content (TFC)**

The total flavonoid contents of the extracts were determined by the aluminium chloride colorimetric method (Dewanto et al. 2002). The different extract solutions (1ml containing 1000 µg/ml) were diluted with 4ml of distilled water in a 10ml volumetric flask. Thereafter, 0.3ml of 5% sodium nitrite solution was added to each volumetric flask; 5 min later, 0.3ml of 10% aluminium chloride was added; 1 min later, 2 ml of 1.0 M sodium hydroxide was added and finally, 2.4 ml of distilled water was then added to the reaction flask and mixed well. Absorbance of the reaction mixture was read at 510nm. Rutin, a standard flavonoid, in the range of 5 - 150 µg/ml was used to prepare a standard reference curve. Total flavonoid contents (TFC) of the extracts were expressed as Rutin Equivalents (RE) from the linear regression curve of Rutin.

**DPPH Radical Scavenging Assay**

The ability of the test extracts to scavenge stable DPPH radicals was measured in this assay (Mensor et al. 2001). Different concentrations (5 - 40 µg/ml) of the extracts were prepared in methanol. To 2.5 ml of each extract solution concentration was added 1 ml of 0.3mM of freshly prepared DPPH solution in methanol and allowed to react in the dark at room temperature for 30 min. Absorbance of the resulting solution was measured at 518 nm. Methanol (1 ml) added to 2.5 ml of each extract concentration was used as blank, while 1 ml of 0.3mM DPPH solution added to 2.5 ml of methanol served as a negative control. Ascorbic acid and gallic acid were used as standard reference compounds. Percentage DPPH scavenging ac-
Activities of the extracts and standards were determined using the formula:

\[ \% \text{ scavenging activity} = 100 - \left( \frac{(A_s - A_b)}{A_c} \right) \times 100, \]

where \( A_s \) = Absorbance of sample (containing extract or standard); \( A_b \) = Absorbance of blank; \( A_c \) = Absorbance of negative control.

Results were expressed as IC\(_{50}\) (concentration of extract / standard required to scavenge 50\% of DPPH radicals), which were determined from a linear regression curve of concentration versus % scavenging activity.

**Metal (Ferrous ion) Chelating Activity**

The ferrous ion chelating activity of the extracts was measured by monitoring the decrease in the absorbance at 562 nm of the iron (II)-ferrozine complex (Dinis et al. 1994). One milliliter of 0.125 mM FeSO\(_4\) and 1.0 ml of 0.3125 mM ferrozine were mixed with 1.0 ml of different concentrations (50 – 1000 µg/ml) of extract. The mixture was allowed to equilibrate for 10 min before measuring the absorbance. Sample solutions at different concentrations were used as blanks as the extracts may also absorb at this wavelength. Ethylenediaminetetraacetic acid disodium salt (Na\(_2\)EDTA) was used as a standard metal chelator. The ability of the extracts to chelate ferrous ion was calculated relative to the control (consisting of iron and ferrozine only) using the formula:

\[ \text{Chelating activity (\%) = } \left( \frac{A_{\text{control}} - A_{\text{sample}}}{A_{\text{control}}} \right) \times 100, \]

Results were expressed as IC\(_{50}\) (concentration required to chelate 50\% of ferrous ions) from linear regression curve of concentration versus % chelating activity.

**Hydroxyl (OH) Radical Scavenging Assay**

The hydroxyl radical scavenging activity of the test extracts was determined by the Fenton reaction using the ortho-phenanthroline method according to the modified procedure of Nagulendran et al. (2007). 4 ml of sodium phosphate buffer (0.2M, pH 7.4), 1.5 ml of 5mM orthophenanthroline (1, 10 phenanthroline) in ethanol and 1 ml of 7.5mM Iron (II) sulphate were mixed in a quick move. Then, 1 ml of the extracts and references at different concentrations (0.25 – 2.5 mg/ml), 1.5 ml of distilled water and 1 ml of 1% hydrogen peroxide were added to the mixture in sequence. After incubating at 37\(^\circ\)C for 60 min, the change of reaction mixture in absorbance, caused by the colour change of Fe-orthophenanthroline was measured at 510 nm. A damage control (control in the hydroxyl radical generation system) was constituted with distilled water in place of extracts and references. A blank was constituted with distilled water, without sample and hydrogen peroxide. Hydroxyl radicals scavenging activity was evaluated as:

\[ \text{Scavenging Activity (\%) = } \left( \frac{(A_s - A_o)}{A_b - A_o} \right) \times 100, \]

Where \( A_s \) = Absorbance of reaction mixture with sample, \( A_o \) = Absorbance of damage control and \( A_b \) = Absorbance of blank

**Total Antioxidant Capacity (TAC)**

The total antioxidant capacity of the test extracts were determined by the phosphomolybdate method (Jayaprakasha et al. 2002). An aliquot (300 µl) of different concentrations (20 – 100 µg/ml) of the extracts were mixed with 3 ml of the reagent solution (0.6 M H\(_2\)SO\(_4\), 28mM sodium phosphate, 4mM ammonium molybdate) taken in test tubes. The tubes were capped with aluminium foil and incubated in a boiling water bath at 95\(^\circ\)C for 90 min. The reaction mixture was allowed to cool to room temperature and the absorbance of the solution was measured at 695 nm against a blank (containing 3 ml of reagent solution and the appropriate volume of solvent used to dissolve the extracts). The blank was incubated under same conditions as the test samples. Ascorbic acid and gallic acid were used as standard reference compounds.

**Reducing Power Assay**

Antioxidant activity of the test extracts was determined in this assay as the ability to reduce Fe\(^{3+}\) (Sheetal et al. 2007). Different concentrations (20 – 100 µg/ml) of each extract were pre-
pared and 1 ml of each was mixed with 2.5 ml of phosphate buffer (0.2M, pH 6.8) and 2.5 ml of potassium ferricyanide. The mixture was incubated in a water bath at 50ºC for 20 min. To this mixture, 2.5 ml of 10% trichloroacetic acid was added and then centrifuged at 3000 rpm for 10 min. The upper layer of the solution (2.5 ml) was mixed with 2.5 ml of distilled water and 0.5 ml of 0.1% ferric chloride was added. Absorbance of the blue solution formed was measured at 700 nm. Ascorbic acid and gallic acid were used as standard reference compounds. Increasing absorbance indicated increasing reducing power.

Statistical analyses

The student’s t-test was used to compare the two plant extracts in most of the assays. IC₅₀ values, where calculated, were obtained from appropriate linear regression curves. Analysis of variance (ANOVA) was also used, where necessary, to compare the extracts with the reference standards in some of the assays. Mean separation was done using the Least Significant Difference (LSD). All results are presented as mean ± standard error.

**Results**

**Extract yield**

_Eremomastax polysperma_ yielded significantly (p<0.05) more extract (14.04% of starting dried milled sample) than _Eremomastax speciosa_ with a mean extract yield of 11.74% (Table 1).

**Table 1:** Extract yield (%), Total phenol and flavonoid contents, IC₅₀ values for DPPH scavenging, Metal Chelating and Hydroxyl radical scavenging activities of _E. speciosa_ and _E. polysperma_ extracts.

<table>
<thead>
<tr>
<th>Extract</th>
<th>Extract Yield (%</th>
<th>TPC (µg GAE/mg)</th>
<th>TFC (µg RE/mg)</th>
<th>DPPH radical (µg/ml) *</th>
<th>Metal Chelating (mg/ml) **</th>
<th>Hydroxyl radical (mg/ml) ***</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. speciosa</em></td>
<td>11.74 ± 0.75</td>
<td>36.44 ± 0.85</td>
<td>67.83 ± 3.75</td>
<td>89.14 ± 2.02</td>
<td>1.21 ± 0.003</td>
<td>30.23 ± 1.96</td>
</tr>
<tr>
<td><em>E. polysperma</em></td>
<td>14.04 ± 0.32</td>
<td>57.56 ± 0.78</td>
<td>141.58 ± 9.17</td>
<td>40.76 ± 0.94</td>
<td>1.14 ± 0.003</td>
<td>23.18 ± 0.59</td>
</tr>
</tbody>
</table>

*IC₅₀ values for ascorbic acid and gallic acid are 5.95 ± 0.13 µg/ml and 0.50 ± 0.02 µg/ml, respectively.

**IC₅₀ value for Na₂EDTA is 0.02 ± 0.001 mg/ml

***IC₅₀ value for ascorbic acid is 31.37 ± 0.39

Results are presented as mean ± standard error

Means with different superscripts along each vertical array differ significantly (p<0.05) from each other.

**Total Phenol Content**

Total phenol contents of the extracts were obtained from a linear regression curve (y = 0.1404 + 0.0137x, r² = 0.970) of gallic acid, a standard phenol. Extract of _Eremomastax polysperma_ contained significantly (p<0.05) more mean total phenols (57.56 µg GAE/mg) than _Eremomastax speciosa_ extract with a mean phenol content of 36.44 µg GAE/mg (Table 1).

**Total Flavonoid Content**

The total flavonoid contents of the extracts were obtained from a linear regression curve (y = 0.0551 + 0.0012x, r² = 0.984) of rutin, a standard flavonoid. Mean total flavonoid content in the extract of _Eremomastax polysperma_ (141.58 µg RE/mg) was significantly (p<0.05) higher than the mean total flavonoid content in _Eremomastax speciosa_ extract (67.83 µg RE/mg) (Table 1).

**DPPH Radical Scavenging Assay**

_Eremomastax polysperma_ extract showed significantly (p<0.05) more potency in scavenging stable DPPH free radicals (IC₅₀ = 40.76 µg/ml) compared to the extract of _Eremomastax speciosa_ (IC₅₀ = 89.14 µg/ml) which scavenged 50% of the radicals at a higher concentration. Both extracts were, however, less potent in DPPH scavenging when compared to ascorbic acid (IC₅₀ = 5.95 µg/ml) and gallic acid (IC₅₀ = 0.50 µg/ml) used as standards. Results are presented in Table 1.
Metal Chelating Activity

The results of the ferrous ion chelating activity of the test extracts are presented in Table 1. Extract of *Eremomastax polysperma* had a significantly (*p*<0.05) higher mean chelating potency (IC$_{50}$ = 1.14 mg/ml) than the extract of *Eremomastax speciosa* (IC$_{50}$ = 1.21 mg/ml). Na$_2$EDTA, which was used as a standard chelator, was superior (IC$_{50}$ = 0.02 mg/ml) to the tested extracts.

Hydroxyl Radical Scavenging Assay

The results of hydroxyl scavenging activities of the test extracts are presented as IC$_{50}$ values in Table 1. The extract of *Eremomastax polysperma* was more potent (*p*<0.05) in scavenging hydroxyl radicals with a mean IC$_{50}$ of 23.18 mg/ml as against *Eremomastax speciosa* extract that scavenged 50% of the radicals at a higher concentration of 30.23 mg/ml. Ascorbic acid scavenged 50% of the radicals at a mean concentration of 31.37 mg/ml, indicating inferior activity.

Total Antioxidant Capacity (TAC)

The total antioxidant capacity of the test extracts were measured and expressed as mean absorbance values at 695 nm (Table 2). Significant differences (*p*<0.05) were obtained between *E. polysperma* extract (0.105) and *E. speciosa* extract (0.074) in the reduction capacity for Mo (VI) ions. Gallic acid and ascorbic acid used as standards were superior to the extracts in total antioxidant capacity with mean absorbance values of 0.437 and 0.868, respectively. Generally, the total antioxidant capacities of both the test extracts and standards showed a dose-dependent increase at the different concentrations tested (Figure 2).

Reducing Power

The results of reducing power showed that *Eremomastax polysperma* extract had significantly (*p*<0.05) higher iron (III) reducing potential than the extract of *Eremomastax speciosa*, with mean absorbance values of 0.753 and 0.693 respectively (Table 2). Ascorbic acid, used as a standard reference compound, was superior in reducing potential (2.244) compared to the extracts. Both extracts and the standard maintained a dose dependent increase in reducing potential at the different concentrations tested (Figure 3).

![Figure 2: Total Antioxidant Capacity (TAC) of Eremomastax extracts and reference compounds at the different concentrations tested.](http://www.openaccessscience.com)

![Figure 3: Reducing power of Eremomastax extracts and reference compound at the different concentrations tested.](http://www.openaccessscience.com)

<table>
<thead>
<tr>
<th>Extract</th>
<th>TAC Absorbance at 695 nm</th>
<th>Reducing Power Absorbance at 700 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. speciosa</em></td>
<td>0.074 ± 0.005</td>
<td>0.693 ± 0.011</td>
</tr>
<tr>
<td><em>E. polysperma</em></td>
<td>0.105 ± 0.006</td>
<td>0.753 ± 0.002</td>
</tr>
</tbody>
</table>

*Mean absorbance values for ascorbic acid and gallic acid are 0.868 ± 0.040 and 0.437 ± 0.006, respectively.

**Mean absorbance value for ascorbic acid is 2.244 ± 0.070.

Results are presented as mean ± standard error

Means with different superscripts along each vertical array differ significantly (*p*<0.05) from each other.
Discussion

Natural antioxidants of plant origin are currently being advocated for use in the concerted global efforts against free radicals’ induced oxidative damages, from the point of view of safety. A giant leap in this regard, and hence improved global healthcare delivery system will only be achieved if every potential candidate, including indigenous, exotic and even underutilized species are screened in order to obtain a wider base from which promising species can be harnessed optimally. *Eremomastax speciosa* and *Eremomastax polysperma* lend themselves nicely to this global search owing to their long term use in traditional herbal remedy, and the relatively large amount of flavonoids (antioxidant compounds) reported in their phytochemical screening.

The extract yield from *E. polysperma* was higher than that obtained from *E. speciosa*. This difference may also naturally imply that more of the antioxidant compounds were present in the extract from *E. polysperma* than *E. speciosa*.

Phenols and flavonoids are important phytochemicals whose chemical nature, especially the presence of hydroxyl functional groups, makes them good antioxidants. Phenols are highly electron donating, while flavonoids are potent radical scavengers, peroxidation inhibitors and metal chelators (Nickavar et al. 2007). The high amounts of phenols and flavonoids in extracts may explain their high antioxidant activities (Cook and Samman, 1996), and it has been explained that a diet rich in flavonoids is inversely correlated with cell aging, lipid peroxidation, cancer, etc (Ferreira et al. 2010). In the current study, extracts of *Eremomastax* species contained good levels of these phytochemicals indicating their potential usefulness as antioxidants. These constituent phytochemicals, especially flavonoids may also act as synergists with other compounds produced by the plants to provide enhanced biological activity. An example is seen in the case of *Artemisia annua* where the use of the plant’s flavonoids in combination with artemisinin might provide a more effective treatment for malaria than artemisinin alone (Ferreira et al. 2010). *Eremomastax polysperma* extract however contained more phenols and flavonoids than *E. speciosa* extract. This difference in phytochemical levels may be ascribed to inherent genetic factors. This is similar to reports in tomato where differences in levels of phytochemicals depended greatly on genotype (Giuntini et al. 2005). Comparatively however, the levels of antioxidant phytochemicals reported in this study for these species are higher than were reported in our earlier studies on antioxidant potentials of some underutilized species – *Ocimum species* (Uyoh et al. 2013a), *Monodora myristica* and *Piper nigrum* (Uyoh et al. 2013b).

In the DPPH scavenging assay, antioxidants are evaluated on their ability to decolorize stable DPPH free radicals by electron donation (Saha et al. 2008). The test extracts showed remarkable potency in the scavenging of DPPH radicals. Although not comparable to the standard references, results obtained are an adequate validation that the evaluated plants are potent radical scavengers that could find application as useful natural antioxidants. *E. polysperma*, which had a lower IC$_{50}$ value, showed more potency in DPPH scavenging than *E. speciosa*, indicating a higher ranking in antioxidant potential.

Metal chelators function as first line defense antioxidants in living systems (Niki 2010). They usually act by forming a stable iron (II) chelate with ferrous ions thus, decreasing the extent of Fenton reaction which is implicated in many diseases (Farombi et al. 2000). The chelating ability of an extract, therefore, measures how effective the compounds in it can compete with ferrozine for ferrous ion. The iron–ferrozine complex has maximum absorbance at 562 nm and a large decrease in absorbance (in the presence of chelators) indicates strong chelating power. *Eremomastax polysperma* ranked higher (with a lower IC$_{50}$ value) than *Eremomastax speciosa* in metal chelating potency. Although both extracts did not compare with Na$_3$EDTA, a standard metal chelator, they showed antioxidant potential as chelators with capacity to confer a first line protection on human cells from oxidative diseases that could be initiated by ferrous ions. The hydroxyl radical scavenging activities of both plant extracts evaluated in this study and ascorbic acid used for comparison were generally not very potent as it required relatively high concentrations of the test substances to scavenge 50% of the radicals. However,
the ability of the extracts to scavenge the highly reactive and damaging hydroxyl radical in vitro may suggest that the extracts could also confer protective functions to important biomembranes and bio molecules against attack by free radicals (Farombi et al. 2000).

An important mechanism of antioxidant action is the reduction of metal ions. Thus, a potent antioxidant often acts as a potent reductant (Niki 2010). Reducing power and total antioxidant capacity assays were used to evaluate the ability of the test extracts to reduce \( \text{Fe}^{3+} \) and \( \text{Mo}^{(VI)} \) to their lower valence states – \( \text{Fe}^{2+} \) and \( \text{Mo}^{(V)} \) respectively, through electron donating. Results obtained are clear indications that reduction transformation occurred in the presence of the extracts confirming that they contain reductants which could serve as antioxidants. The presence of these reducing compounds is also a demonstration that the extracts could serve as electron donors and consequently can terminate free radical chain reactions in human and animal cells. Reducing potential of *Eremomastax polysperma* was higher in both assays than for *Eremomastax speciosa* suggesting a better usefulness of the former as a natural antioxidant.

**Conclusions**

On the basis of the results obtained from this preliminary study, it can be concluded that *Eremomastax polysperma* and *Eremomastax speciosa* possess quite some remarkable antioxidant potential that should necessitate an upgrade in their medicinal value chain. Their continued neglect and restriction to traditional herbal use is unwarranted rather, further confirmation of the antioxidant potential in *in vivo* experiments should be undertaken to provide a more concrete basis for wider exploitation.

**References**


