Antioxidant potential of the extracts of *Putranjiva roxburghii*, *Conyza bonariensis*, *Woodfordia fruticosa* and *Senecio chrysanthemoids*

Durre Shahwar¹*, Muhammad Asam Raza², Afifa Saeed¹, Madiha Riasat¹, Faiza Ilyas Chattha¹, Merva Javaid¹, Sami Ullah¹ and Saif Ullah¹

¹Research Laboratory II, Department of Chemistry, Government College University, Lahore-54000, Pakistan.
²Department of Chemistry, University of Gujrat, Hafiz Hayat Campus, Gujrat, Pakistan.

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*Putranjiva roxburghii*, *Conyza bonariensis*, *Woodfordia fruticosa* and *Senecio chrysanthemoids* were collected from different areas of Pakistan and extracted in methanol. The crude methanolic extract was dissolved in water and further partitioned with n-hexane, chloroform and n-butanol successively. Total phenols of all extracts were calculated using Folin-Ciocalteu (FC) reagent, while antioxidant activities were determined using standard protocols. All extracts contained reasonable amount of phenolic contents ranging from 36.9 ± 0.3 to 911.7 ± 1.4 mg GAE/g of extract, and maximum total phenols were present in the ethyl acetate extract of *S. chrysanthemoids* (911.7 ± 1.4 mg GAE/g of extract). Antiradical activity was measured as decrease in absorbance at 517 nm using diphenylpicrylhydrazyl radical (DPPH). The ethyl acetate extract of *W. fruticosa* exhibited the highest activity (92.1 ± 1.6% with IC₅₀ = 4 ± 0 µg). The reducing potential of the extracts was determined with ferric reducing antioxidant power (FRAP) and total antioxidant capacity (TAC) assays. The ethyl acetate extract of *C. bonariensis* showed the highest activity in FRAP (671.9 ± 1.6 µM) and the extract of *W. fruticosa* (ethyl acetate) was the most active (1.882 ± 0.041) in TAC among the other extracts of the selected medicinal plants.

Key words: DPPH, FRAP, TAC, medicinal plants.

INTRODUCTION

Cellular damage caused by the free radicals or reactive oxygen species (ROS) now appears to be the fundamental mechanism involved in a number of human neurodegenerative disorder, inflammation, diabetes, viral infections, digestive system disorders and autoimmune pathologies (Atawodi, 2005). In living systems, free radicals are generated through normal metabolism of drugs, environmental chemicals and other xenobiotics as well as endogenous chemicals, especially stress hormones (adrenalin and noradrenalin) (Sini et al., 2010). ROS can be scavenged through chemoprevention utilizing natural antioxidant compounds present in medicinal plants. Natural antioxidants such as phenolic compounds, are gaining importance due to their benefits for human health, decreasing the risk of degenerative diseases by reduction of oxidative stress and inhibition of macromolecular oxidation (Silva et al., 2004; Pulido et al., 2000; Tseng et al., 1997).

*Putranjiva roxburghii* Wall, also known as *Drypetes roxburghii* (Wall), is a member of the Euphorbiaceae family. It is widely grown in Thailand, Nepal, Bangladesh, India, Indochina, Myanmar and Sri Lanka (Phuphathanaphong and Chayamarit, 2006). In folklore medicine, its leaves and fruits have been traditionally used for the treatment of fever, muscle twisting, arthralgia and rheumatism (Boonyaprapat and Chokechaicharoenporn, 1999). It is also used as antinociceptive, antipyretic, anti-inflammatory and the whole plant of *P. roxburghii* has been used for the...
treatment of fever and hemorrhoids. Two triterpenoids, namely putranjivanol and putranjic acid, were isolated from the trunk bark of *P. roxburghii* (Garg and Mitra, 1968). The isolation of four other triterpenoids, friedelin, putranjivadiol, friedelanol and roxburgholone, from the bark of *P. roxburghii* has also been described (Sengupta and Mukherjee, 1968). Roxburghonic acid, a triterpene acid, and putraflavone, a biflavonoid, were isolated from the alcoholic extract of *P. roxburghii* leaves (Garg and Mitra, 1971).

The genus Conyza composed of 50 species which are found on the tropical Himalaya from Nepal to Sikhim, extending to Assam, Khasia hills, Chittagong and Burma. The species *C. bonariensis* (Asteraceae) is distributed in many parts of the Punjab province along the edges of roads, gardens and maize lands. The genus Conyza is found to be very rich in terpenoids such as celarodanes (Zdero et al., 1990), sesquiterpenes (Bohmann and Wagner, 1982) and diterpenes (Ahmad et al., 1992; Mata et al., 1997). Woodfordia fruticosa Kurz (Woodfordia floribunda Salisb.) belonging to the Lythraceae family, is abundantly present throughout India, and also in a majority of the countries of South East and Far East Asia like Malaysia, Indonesia, Sri Lanka, China, Japan and Pakistan, as well as Tropical Africa (Kirtikar and Basu, 1935). It is a much-used medicinal plant in Ayurvedic and Unani systems of medicines (Chopra et al., 1956). Although all parts of this plant possess valuable medicinal properties (Chougale et al., 2009), there is a heavy demand for the flowers, both in domestic and international markets specialized in the preparation of herbal medicines (Oudhia, 2003). According to the Indian Systems of Medicine, this flower is pungent, acrid, cooling, tonic, alexerteric, uterine sedative and anthelmintic, and is useful in dysentery, leprosy, erysipelas, blood diseases, leucorrhoea, menorrhagia and toothache. The compounds identified are predominantly phenolics (phenolic acids, flavonoids and hydrolysable tannins) (Desai et al., 1971). The other non-phenolic constituents reported include the triterpenoids lupeol, betulin, betulinic acid, oleanolic acid and ursolic acid from the leaves (Dan and Dan, 1984).

The genus Senecio (family: Asteraceae) consists of more than 1,500 species of aromatic herbs and shrubby plants native to Southern Europe, but now spread all over the world (Joffe, 2001). It is herbaceous, common in Pakistani’s flora, along roadsides, waste grounds, forests and crops and the plains to the mountain zone. Senecio species contain a large variety of pyrrolizidine alkaloids, flavonoids, volatile oils, steroids, triterpenes, tannins, fatty acids, sugars and vitamins (Bohlman et al., 1986; Bohlmann and Ziesche, 1981). The aerial parts of Senecio species are used as traditional remedies for treatment of asthma, coughs, bronchitis, enemas in chest complaints, eczema and wound healing (Yang et al., 2011).

The aim of the present study was to determine a link between the antioxidant activity and traditional uses of the selected medicinal plants against various diseases such as ulcer, diabetes and neurodegenerative diseases. To the best of our knowledge, antioxidant activity of the selected plants has not been reported on stems.

**MATERIALS AND METHODS**

**Chemicals and reagents**

Folin-Ciocalteu reagent (FC), 2,4,6-tris(2-pyridyl)-s-triazine (TPTZ), 2, 2′-diphenyl-1-picrylhydrazyl (DPPH), gallic acid, ascorbic acid and quercetin were purchased from Sigma-Aldrich (USA). All other solvents, chemicals and reagents of analytical grade were from Merck (Germany).

**Collection of plant materials**

*C. bonariensis*, *W. fruticosa* and *S. chrysanthemoides* were collected from Azad Kashmir, while *P. roxburghii* was collected from the Botanical Garden, GC University, Lahore. The plants were identified at Botany Department and voucher specimens of all plants were submitted at Sultan Herbarium.

**Extraction**

The stem of *S. chrysanthemoides*, *W. fruticosa* and *P. roxburghii* and *C. bonariensis* were shade dried, pulverized and extracted with methanol separately (300 g each). The crude extracts were filtered and concentrated on rotary evaporator at reduced pressure. Methanolic extracts of all plants were dissolved in water, and fractionated successively with n-hexane, ethyl acetate, chloroform and n-butanol.

**Determination of total phenolic contents**

The total phenolic content was estimated through spectroscopic method (Shahwar et al., 2010a) using FC reagent. For this assay, 0.2 ml of each extract (1 mg/ml) was mixed with 0.05 ml of FC reagent and 0.2 ml of sodium carbonate (10%). The mixtures were shaken thoroughly and made up to 3 ml with distilled water. The absorbance at 760 nm was determined after incubation at room temperature for 30 min. Total phenolic contents were estimated as milligrams of gallic acid equivalent (GAE) per gram of extract by computing with standard calibration curve obtained at different concentrations of gallic acid. Tests were carried out in triplicate.

**DPPH radical scavenging assay**

The radical scavenging ability of different extracts was measured using DPPH (Brand-Williams et al., 1995). Methanol solution (1.0 ml) of all the extract/fraction at various concentrations (0.01 to 1.5 mg/ml) was added to 1.0 ml (0.2 mg/ml) methanol solution of DPPH and kept in dark. The decrease in absorbance at 517 nm was noted after 30 min. Tests were carried out in triplicate. The % scavenging of radical was determined by the following formula:

\[
\% \text{ inhibition of DPPH} = \frac{A - B}{A} \times 100
\]
Where A is the absorbance of blank and B is the absorbance of sample.

**Ferric reducing antioxidant power (FRAP)**

Ferric reducing antioxidant power assay of extracts and organic
soluble fractions was carried out using 2,4,6-tri(2-pyridyl)-1,3,5-
triazine (Shahwar et al., 2010b). One hundred and fifty microliters
of FRAP reagent was mixed with sample and absorbance was read
at 595 nm after 15 min. The results were expressed in µM
equivalent to FeSO$_4$.7H$_2$O by calculating from calibration curve.
Tests were carried out in triplicate.

**Evaluation of total antioxidant capacity by phosphomolybdate method**

The total antioxidant capacity of the plant extract/fraction was
evaluated by the method of Prieto et al. (1999). An aliquot of 0.2 ml
(500 µg/ml) of the sample solution was mixed with 2.0 ml of the
reagent solution (600 mM sulfuric acid, 28 mM sodium phosphate
and 4 mM ammonium molybdate). The reaction mixture was
incubated at 95°C for 60 min and absorbance was measured at 695
nm against a blank containing 2 ml of reagent solution. Tests were
carried out in triplicate.

**Statistical analysis**

All the experiments were performed in triplicate and statistical
analysis were made with one way ANOVA. Statistical calculation
was performed using SPSS 15.0 software.

**RESULTS**

**Determination of radical scavenging activity**

In vitro assessment of antioxidant potency is commonly
carried out using DPPH radical, which is a very stable
organic free radical that shows absorption maxima at 517
nm. It loses chromophoric group upon receiving a proton
and becomes yellow. As the radical, it is very sensitive to
the presence of hydrogen donors (therefore the assay
needs very low concentration) and a large number of
samples can be evaluated in a short time. Table 1 reports
the results of DPPH assay of all the extracts of the
selected plants. Remarkable results were obtained with
ethyl acetate extracts of all the tested plants in the
decreasing order WFE > PRE > CBE, except S.
chrysanthemoids (SCE) followed by the methanolic
extracts (WFM > CBM > PRM). The butanolic extracts
were also significantly active and the result of % inhibition
was in the range of 58.8 ± 0.4 to 80.6 ± 0.9%. Moreover,
CBC of C. bonariensis showed comparatively higher
inhibition % than PRC of P. roxburghii (Figure 1). Water
extracts of the selected plants showed moderate results,
except CBW.

IC$_{50}$ values were calculated in terms of 50% inhibition
of the available radical and the results are presented in
Table 1. A quantitative difference in the IC$_{50}$ values of all
the extracts was determined. Significant results of IC$_{50}$
values were shown by WFE, WFM and PRE (IC$_{50}$ = 4 ± 0,
4 ± 1 and 5 ± 1 µg, respectively) comparable with the
standard (gallic acid, IC$_{50}$ = 2 ± 0 µg).

**Determination of reducing capacity**

The reducing capacity of a compound is an indication of
its antioxidant activity. FRAP assay is based upon the
reduction of Fe$^{3+}$ ions by the sample and estimation of
the colored complex of Fe$^{2+}$ with TPTZ (2,4,6-tri(2-
pyridyl)-1,3,5-triazine) at 595 nm. The data is expressed
in terms of Fe$^{2+}$ equivalents.

It was noticed that the same plant extracts showing
substantial antioxidant activity against DPPH radical also
showed reducing activity against Fe$^{3+}$ ions in FRAP
assay, although FRAP equivalent values were lower in
the latter case for P. roxburghii and W. fruticosa. Sur-
prisingly, hexane extracts of C. bonariensis was found
second in the order of FRAP results (CBE > CBH > CBC
> CBM > CBW). Among all the extracts, polar extracts of
W. fruticosa except WFW showed significant results in
the FRAP assay (Figure 2).

**Total antioxidant capacity**

Total antioxidant capacity of the extracts were calculated
using phosphomolybdate assay which is based upon the
color measurement of a green colored phospho-
molybdenum (V) complex formed through reduction of
Mo (VI) and shows a maximum absorbance at 700 nm. The results obtained for all other extracts were in the
range of 0.692 ± 0.029 to 1.882 ± 0.041 (Table 1, Figure
3).

**Determination of total phenols**

The amount of total phenolic contents expressed as mg
GAE/g of extract varied widely among plant extracts and
ranged from 36.9 ± 0.3 to 373.6 ± 1.4 mg GAE/g of
extract in P. roxburghii, 505.2 ± 1.0 to 891.3 ± 1.6 mg
GAE/g of extract in W. fruticosa, 108.6 ± 0.7 to 395.6 ±
1.1 mg GAE/g of extract in C. bonariensis, and 150.6 ±
0.6 to 911.7 ± 1.4 mg GAE/g of extract in S.
chrysanthemoids (Table 1).

**Correlation between total phenols and antioxidant activities**

The antioxidant activities of the extracts of C.
Table 1. Total phenol and antioxidant activities of the extracts of *P. roxburghii*, *C. bonariensis*, *W. fruiticosa* and *S. chrysanthemoids*.

<table>
<thead>
<tr>
<th>Sample/Standards</th>
<th>Total phenols</th>
<th>% inhibition</th>
<th>IC₅₀ (µg)</th>
<th>FRAP</th>
<th>Total Antioxidant capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Putranjiva roxburghii</em></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>PRM</td>
<td>176.0 ± 1.3</td>
<td>76.1 ± 1.0</td>
<td>119 ± 4</td>
<td>576.2 ± 1.4</td>
<td>1.029 ± 0.056</td>
</tr>
<tr>
<td>PRH</td>
<td>-</td>
<td>29.5 ± 0.4</td>
<td>-</td>
<td>22.1 ± 0.5</td>
<td>1.016 ± 0.031</td>
</tr>
<tr>
<td>PRC</td>
<td>150.0 ± 0.8</td>
<td>69.4 ± 0.5</td>
<td>265 ± 5</td>
<td>490.1 ± 1.1</td>
<td>0.992 ± 0.026</td>
</tr>
<tr>
<td>PRE</td>
<td>373.6 ± 1.4</td>
<td>91.9 ± 2.3</td>
<td>5 ± 1</td>
<td>638.7 ± 1.3</td>
<td>1.393 ± 0.062</td>
</tr>
<tr>
<td>PRB</td>
<td>59.2 ± 0.6</td>
<td>58.8 ± 0.4</td>
<td>492 ± 4</td>
<td>260.3 ± 0.7</td>
<td>0.996 ± 0.043</td>
</tr>
<tr>
<td>PRW</td>
<td>36.9 ± 0.3</td>
<td>52.7 ± 0.2</td>
<td>444 ± 6</td>
<td>204.0 ± 0.5</td>
<td>0.863 ± 0.019</td>
</tr>
<tr>
<td><em>Coryza bonariensis</em></td>
<td></td>
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</tr>
<tr>
<td>CBM</td>
<td>241.3 ± 0.9</td>
<td>78.7 ± 0.3</td>
<td>230 ± 3</td>
<td>410.3 ± 1.0</td>
<td>0.728 ± 0.034</td>
</tr>
<tr>
<td>CBH</td>
<td>167.9 ± 1.1</td>
<td>62.84 ± 1.6</td>
<td>336 ± 4</td>
<td>449.5 ± 1.3</td>
<td>0.692 ± 0.029</td>
</tr>
<tr>
<td>CBC</td>
<td>304.7 ± 1.5</td>
<td>74.08 ± 1.3</td>
<td>223 ± 5</td>
<td>444.1 ± 0.9</td>
<td>0.950 ± 0.062</td>
</tr>
<tr>
<td>CBE</td>
<td>395.6 ± 1.1</td>
<td>90.3 ± 0.8</td>
<td>89 ± 3</td>
<td>671.9 ± 1.6</td>
<td>0.875 ± 0.051</td>
</tr>
<tr>
<td>CBB</td>
<td>108.6 ± 0.7</td>
<td>67.81 ± 1.3</td>
<td>251 ± 6</td>
<td>367.4 ± 1.1</td>
<td>0.996 ± 0.043</td>
</tr>
<tr>
<td>CBW</td>
<td>-</td>
<td>15.1 ± 0.3</td>
<td>-</td>
<td>26.4 ± 0.6</td>
<td>0.996 ± 0.068</td>
</tr>
<tr>
<td><em>Woodfordia fruiticosa</em></td>
<td></td>
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</tr>
<tr>
<td>WFM</td>
<td>771.7 ± 1.4</td>
<td>84.4 ± 1.5</td>
<td>4 ± 1</td>
<td>201.1 ± 1.0</td>
<td>1.520 ± 0.062</td>
</tr>
<tr>
<td>WFH</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>WFC</td>
<td>505.2 ± 1.0</td>
<td>58.9 ± 0.2</td>
<td>147 ± 2</td>
<td>144.2 ± 0.7</td>
<td>1.136 ± 0.069</td>
</tr>
<tr>
<td>WFE</td>
<td>891.3 ± 1.6</td>
<td>92.1 ± 1.6</td>
<td>4 ± 0</td>
<td>222.2 ± 0.9</td>
<td>1.882 ± 0.041</td>
</tr>
<tr>
<td>WFB</td>
<td>815.2 ± 1.2</td>
<td>80.6 ± 0.9</td>
<td>80 ± 3</td>
<td>190.3 ± 0.4</td>
<td>1.613 ± 0.050</td>
</tr>
<tr>
<td>WFW</td>
<td>660.1 ± 0.8</td>
<td>65.4 ± 0.8</td>
<td>190 ± 4</td>
<td>151.6 ± 0.6</td>
<td>1.455 ± 0.059</td>
</tr>
<tr>
<td><em>Senecio chrysanthemoids</em></td>
<td></td>
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</tr>
<tr>
<td>SCM</td>
<td>361.7 ± 0.4</td>
<td>37.2 ± 0.4</td>
<td>-</td>
<td>103.6 ± 0.9</td>
<td>0.852 ± 0.035</td>
</tr>
<tr>
<td>SCH</td>
<td>225.7 ± 0.8</td>
<td>19.5 ± 0.3</td>
<td>-</td>
<td>121.5 ± 1.0</td>
<td>0.893 ± 0.041</td>
</tr>
<tr>
<td>SCC</td>
<td>604.0 ± 1.1</td>
<td>39.9 ± 0.4</td>
<td>-</td>
<td>169.1 ± 0.8</td>
<td>1.015 ± 0.062</td>
</tr>
<tr>
<td>SCE</td>
<td>911.7 ± 1.4</td>
<td>57.4 ± 1.6</td>
<td>497 ± 9</td>
<td>193.7 ± 1.2</td>
<td>1.052 ± 0.037</td>
</tr>
<tr>
<td>SCB</td>
<td>879.3 ± 1.0</td>
<td>73.2 ± 1.1</td>
<td>460 ± 6</td>
<td>171.9 ± 1.5</td>
<td>1.041 ± 0.044</td>
</tr>
<tr>
<td>SCW</td>
<td>150.6 ± 0.6</td>
<td>18.6 ± 0.6</td>
<td>-</td>
<td>94.2 ± 1.0</td>
<td>0.751 ± 0.029</td>
</tr>
<tr>
<td>Gallic acid</td>
<td>-</td>
<td>94.3 ± 1.3</td>
<td>2 ± 0</td>
<td>-</td>
<td>1.213 ± 0.046</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>-</td>
<td>92.6 ± 1.0</td>
<td>3 ± 0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Quercetin</td>
<td>-</td>
<td>87.3 ± 0.6</td>
<td>5 ± 1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*a* mg GAE/g of extract; *b* at 500 µg/ml; *c* equivalent to FeSO₄·7H₂O (µM); *d* absorbance at 695 nm; - = not calculated. *P. roxburghii*: in methanol (PRM), in n-hexane (PRH), in chloroform (PRC), in ethyl acetate (PRE), in butanol (PRB) and in water (PRW); *C. bonariensis*: in methanol (CBM), in n-hexane (CBH), in chloroform (CBC), in ethyl acetate (CBE), in butanol (CBB) and in water (CBW); *W. fruiticosa*: in methanol (WFM), in n-hexane (WFH), in chloroform (WFC), in ethyl acetate (WFE), in butanol (WFB) and in water (WFW); *S. chrysanthemoids*: in methanol (SCM), in n-hexane (SCH), in chloroform (SCC), in ethyl acetate (SCE), in butanol (SCB) and in water (SCW).

**DISCUSSION**

An imbalance between ROS (reactive oxygen species)
Figure 1. % DPPH inhibition activity of the extracts of *P. roxburghii*, *C. bonariensis*, *W. fruiticosa* and *S. chrysanthemoids*.

Figure 2. FRAP activity of the extracts of *P. roxburghii*, *C. bonariensis*, *W. fruiticosa* and *S. chrysanthemoids*.
generating and scavenging system which results in cellular damage has been implicated in the pathology of a range of human disorders (Atawodi, 2005). Chemo-preventive capacities of ethnobotanicals with radical scavenging potential has been demonstrated on ulcer (Borelli and Izzo, 2000), diabetes (Sabu and Kuttan, 2002), memory and cognitive function (Howes et al., 2003), Alzheimer’s disease (Howes et al., 2003; Perry et al., 1998), age related neurological dysfunction (Delanty and Dichter, 2000), cardiovascular and renal disorders (Anderson et al., 1999). Hence, therapy using antioxidants (free radical scavengers) may have potential to prevent or delay many of these disorders. The use of traditional medicinal plants with significant antioxidant activity provides an effective strategy to prevent these disorders (Shahwar et al., 2010c).

In the present study, four different species of medicinal plants had been selected on the basis of their traditional uses. Antioxidant activity of the selected plant extracts was determined using DPPH, FRAP and phosphomolybdate methods. According to the results shown in Table 1 for different antioxidant assays, the selected
plants can be ranked as; DPPH, *W. fruiticosa > P. roxburghii > P. roxburghii > C. bonariensis > S. chrysanthemoids: FRAP, C. bonariensis > P. roxburghii > W. fruiticosa > S. chrysanthemoids: TAC, W. fruiticosa > P. roxburghii > S. chrysanthemoids > C. bonariensis*. A literature survey revealed that *W. fruiticosa* has been recommended for peptic ulcer diseases (Das et al., 2006). Recently, a wide range of compounds including flavonoids and polyphenols, have been isolated from this species (Kailidhar et al., 1981; Kadota et al., 1990). High R² values of the correlation studies (Table 2) suggested that the phenolic compounds are responsible for strong antioxidant activity of this plant. Therefore, it can be suggested that the use of *W. fruiticosa* in the prevention of peptic ulcer is correlated with the polyphenols and antioxidant activity (Sumbul et al., 2011).

The extracts of *P. roxburghii* were found second in the order of results of antioxidant activities. Traditionally this plant has been claimed to possess antidiabetic activity (Amit et al., 2010). Many recent studies revealed the involvement of free radicals in the pathogenesis of diabetes (Matteucci and Giampietro, 2000). Antioxidants are effectively used for the prevention of experimentally induced diabetes in animal models as well as diabetes complications (Kubish et al., 1997; Lipinski, 2001; Naziroglu and Cay, 2001). According to results of our studies, antiradical and reducing properties of *P. roxburghii* may be suggested to be directly related to the prevention of diabetes. Moreover, antimicrobial activity of *C. bonariensis* has been reported (Chaudhary et al., 2001), but no significant work related to the phytochemistry of this plant is found in the literature. The extracts of *C. bonariensis* showed a weak correlation with the phenolic contents (Table 2). Therefore, significant results of the hexane extract in the FRAP assay (CBH = 449.5 ± 1.3) can be attributed to the presence of some non-polar constituent.

Furthermore, the aqueous extracts of *S. chrysanthemoids* are used in the folk medicine as antipyretic and calming (Qureshi et al., 2007). The results of antioxidant activity of *S. chrysanthemoids* were found to correlate with total phenols (Table 2). However, higher IC₅₀ values in the DPPH assay could be due to the slow rate of reaction of the antioxidants contained by the extracts (Table 1). In several studies, it has been demonstrated that cyclooxygenase-2 (COX-2) catalyses the synthesis of prostaglandins which mediates fever. The role of antioxidants to control the activity of COX-2 is also well established (Jiang et al., 2000). Therefore, the traditional use of *S. chrysanthemoids* in fever can be attributed to its antioxidant activity.

**Conclusion**

The results of this study provide some scientific credence to the indigenous uses of the selected medicinal plants evaluated for the treatment of the diseases induced by the overproduction of free radicals such as diabetes, peptic ulcer, inflammation and Alzheimer’s disease. The antioxidant activity of the extracts is attributed to the phenolic contents. Consequently, our results suggested that these plant extracts can be utilized as an effective and safe source of natural antioxidants with consequent health benefits. It is proposed that the beneficial effects of these plants in traditional medicine results from their action as antioxidant. Hence, further investigation of the plant extracts that exhibited the highest antioxidant activity need to be carried out, including fractionation, to isolate active constituent and subsequent pharmacological evaluation.

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