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Antioxidant Activity of *Solanum aculeastrum* (Solanaceae) berries

[1]S. Koduru, [1]DS. Grierson, [2]MA. Aderogba, [2]JN. Eloff and [1]AJ. Afolayan
[1]Department of Botany, University of Fort Hare, Alice 5700, South Africa
[2]Programme for Phytomedicine, Department of Paraclinical Sciences,
University of Pretoria, Onderstepoort 0110, Pretoria, South Africa

Abstract: The antioxidant activity of the crude methanol, acetone and water extracts of the berries of *Solanum aculeastrum* was examined by 1,1-diphenyl-2 picrylhydrazyl (DPPH) radical-scavenging. The methanol and water extracts had moderate antioxidant activity ranging between 53.1 to 65.5 μg mL^{-1}, while the acetone extract did not demonstrate significant antioxidant activity at the tested concentrations. The higher antioxidant activity of this plant exhibited by the water extract may be due to the presence of substantial amount of polar constituents from the plant material.

Key words: *Solanum aculeastrum*, antioxidant activity, DPPH, Solanaceae

INTRODUCTION

Solanum aculeastrum Dunal (Solanaceae) is a multi-branched shrub, 1-5 m high, heavily armed with large prickles and is wide-spread in South Africa. It grows in areas with high rainfall of more than 700 mm per year and at altitudes from 275 to 1 780 m on gentle to steep slopes and various soil types. *S. aculeastrum* has high medicinal value. Its berries are used as a soap substitute, apparently because of its high saponin content. Local healers use the extremely bitter berries and leaves for the treatment of various diseases in humans and domestic animals (Hutchings *et al*., 1996). Both mature and immature berries contain the poisonous alkaloid, α-solanine (Hutchings *et al*., 1996). Other bioactive compounds that have been isolated from this plant include solaculine A (Wanyonyi *et al*., 2002) from the root bark and solamargine, beta-solamarine, solasonine and solasodine from the fruits (Drewes and Van Staden, 1995; Wanyonyi *et al*., 2002). The fresh and boiled ripe berries are used as a cure for jigger wounds and gonorrhoea, respectively (Agnew and Agnew, 1994). Recent discussion with traditional healers of the Eastern Cape Province in South Africa revealed that the plant is used for the treatment of cancer, particularly breast cancer.

Many plants in the Solanaceae family accumulate steroidal alkaloids (Tan *et al*., 2005). These compounds are nitrogen analogues of saponins. They are usually present as glycosides and are known to possess a variety of biological properties, including antifungal (Kusano *et al*., 1987), molluscicidal (Alzerreca and Hart, 1982; Wanyonyi *et al*., 2003), teratogenic, embryotoxic (Friedman *et al*., 1992) and hemolytic (Dewick, 1998) properties. They also exhibit strong antioxidant properties (Badami *et al*., 2005). Despite the well reported medicinal values of *S. aculeastrum*, its antioxidant potential has not been studied. In the present investigation extracts of berries of this plant were screened for *in vitro* antioxidant activity.

MATERIALS AND METHODS

Collecting of plant material and extracts preparation: The berries of *S. aculeastrum* were collected from shrubs naturally occurring in the wild at Kayalethu village in the Eastern Cape Province of South Africa (latitudes 30°00'- 34°15'S and longitudes 22°45'-30°15'E). The fruits were oven dried at 60°C overnight. Two hundred gram portions of dried plant material were shaken separately in methanol, acetone and water for 48 h on an orbital shaker. Extracts were filtered using a Buchner funnel and Whatman No. 1 filter paper. The methanol and acetone filtrates were concentrated to dryness under reduced pressure at 40°C using a rotary evaporator, while the water extract was freeze dried.

Evaluation of antioxidant activity: Quantitative antioxidant activity was determined spectrophotometrically as described by Mensor *et al*. (2001), with reactions carried out in 96-well microtitre plates. Briefly, different concentrations of the extracts were prepared between 250.0 and 1.0 μg mL^{-1}. Twenty microliter of 0.3 mM DPPH

Corresponding Author: A.J. Afolayan, Department of Botany, University of Fort Hare, Alice 5700, South Africa
Tel: 0822022167 Fax: 040 6022323

in ethanol was added to 50 µL of each concentration of sample tested and allowed to react at room temperature in the dark for 30 min. Blank solutions were prepared with the test solution (50 µL) and 20 µL of ethanol only while the negative control was DPPH solution (20 µL), plus 50 µL ethanol. The decrease in absorbance was measured at 518 nm on a micro plate reader ($VERSA_{max}$). Values obtained were converted to percentage antioxidant activity (AA%) using the formula:

$$AA\% = 100 - \{[(Abs_{sample} - Abs_{blank}) \times 100] / Abs_{control}\}$$

(Abs_{sample} is the absorbance of the sample, Abs_{blank} is the absorbance of the blank and $Abs_{control}$ is the absorbance of the control). L-ascorbic acid (Vitamin C) was used as a positive control (antioxidant agent).

The EC_{50} value, defined as the concentration of the sample leading to 50% reduction of the initial DPPH concentration, was calculated from the linear regression of plots of concentration of the test extracts (µg mL^{-1}) against the mean percentage of the antioxidant activity obtained from three replicate assays.

Statistical analysis: The results were expressed as mean±SEM and the EC_{50} values obtained from the regression plots (SigmaPlots^{R}2001, SPSS Science) showed a good coefficient of determination, with most values being $r^2 \geq 0.913$.

RESULTS AND DISCUSSION

The radical-scavenging activities of the samples were determined from the reduction in the optical density (OD) of DPPH free radical at 518 nm. Hydrogen-donating ability is an index of the primary antioxidants. These antioxidants donate hydrogen to free radicals, leading to non-toxic species and therefore to inhibition of the propagation phase of lipid oxidation (Lugasi *et al*., 1998). According to Hochstein and Atallah (1998), the antimutagenic activity of antioxidants is due to their ability to scavenge free radicals or induce antioxidative enzymes. The extracts of the berries of *S. aculeastrum* differed in antioxidant activity in quantitative measurement. A low EC_{50} value is an indication of strong antioxidant activity. Methanol and water extracts of berries had moderate antioxidant activity ranging between 53.1 to 65.5 µg mL^{-1} (Table 1), while acetone extract did not demonstrate significant antioxidant activity at the tested concentration. The higher antioxidant activity exhibited by the water extract may be due to the presence of substantial amounts of polar constituents from the plant material.

Table 1: DPPH free radical scavenging activity of berries extracts of *S. aculeastrum*

Extracts	EC50±SEM (µg mL^{-1})
Methanol	65.5±4.90
Acetone	ND
Water	53.10±2.33
L-Ascorbic acid	2.60± 0.08

ND- Not Determined, the sample did not demonstrate considerable antioxidant activity at the highest concentration (250 µg/ml) tested in this experiment.

In *Solanum aculeastrum*, steroidal alkaloid glycosides were isolated from the berries (Wanyonyi *et al*., 2002). This study emphasizes the antioxidant potential of *S. aculeastrum*. The components responsible for the antioxidative activities of the extracts, however, are unknown. Further research is therefore needed for the isolation and identification of the antioxidative components in the extracts.

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