African Journal of Biotechnology Vol. 11(21), pp. 4934-4937, 13 March, 2011
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.529
ISSN 1684–5315 © 2011 Academic Journals

*Full Length Research Paper*

# Phytochemical and antimicrobial properties of *Solanum macranthum* Dunal

**J. O. Olayemi[1]*, E. E. Essien[2], E. O. Ajaiyeoba[1] and O. Ekundayo[2]**

[1]Department of Pharmacognosy, University of Ibadan, Ibadan, Nigeria.
[2]Department of Chemistry, University of Ibadan, Ibadan, Nigeria.

Accepted 15 September, 2011

**Extracts of leaves, stem bark, roots and fruits of *Solanum macranthum* Dunal were subjected to preliminary phytochemical screening for the presence of plant secondary metabolites and *in vitro* antibacterial and antifungal studies respectively. The results of the preliminary investigation revealed the presence of alkaloids, the steroidal nucleus, saponins, tannins, cardiac glycosides, flavonoids, reducing sugars and anthraquinones. The *in vitro* antimicrobial activity was done using agar well diffusion technique. Six clinical strains of human pathogenic microorganisms, comprising two Gram positive, two Gram negative bacteria and two fungi were utilized in the studies. The various plant extracts varied in their high inhibitory activity to *Staphylococcus aureus, Pseudomonas aeruginosa* and *Escherichia coli* at 1000 mg/ml comparable to the reference antibacterial drug, gentamicin at 2.5 mg/ml. High activity was exhibited against *Bacillus subtilis* whilst *Candida albicans* and *Aspergillus niger* were moderately inhibited even at 2000 mg/ml.**

**Key words:** *Solanum macranthum,* Solanaceae, antimicrobial activity, phytochemical screening.

## INTRODUCTION

*Solanum species* (family: Solanaceae) comprises of 1,700 species which are commonly found in the temperate and tropical regions of the world. *Solanum macranthum* Dunal (Syn. *Solanum wrightii* Benth) or 'giant potato tree' is a shrub and an ornamental plant. It is widespread in West Africa (Burkill, 2000). Tolerance to many bacterial and fungal diseases has been reported. When applied to surfaces of plants, they inhibit the growth of bacteria and fungi. Solasodine and other steroidal alkaloids have been isolated and characterized from the plant (Fayez and Saleh, 1967; Hardman, 1969; Walker and Edwards, 1999). Plants of this genus are generally known to contain the alkaloids, solanine or solasodine or both; and solasodine, the nitrogen analogue of diosgenin is pharmacologically accepted as its alternative (Burkill, 2000). Ethnomedicinal values of other Solanum species have been reported. Leaf of *Solanum torvum* is used for the treatment of wound infections, coughs, sore throat while *Solanum erianthum* is reported to have diuretic, purgative properties and active in the treatment of veneral diseases and leprosy (Burkill, 2000). Previous studies on the antimicrobial properties of plants of the Solanaceae family have also been reported (Walker and Edwards, 1999; Chan et al., 2000; Dabur and Sharma, 2002). To the best of our knowledge there are no reports of previous studies on the antimicrobial activity of this plant. We report herein the preliminary phytochemical, antibacterial and anti-fungal properties of the Nigerian grown species as part of our continuing studies on anti infective properties of Nigerian medicinal plants.

*Corresponding author: E-mail: bulayemi@yahoo.com.

## MATERIALS AND METHODS

### Plant collection and authentication

The leaves, fruits, stem bark and roots of *S. macranthum* were collected in October, 2005 within the vicinity of the Department of Chemistry, University of Ibadan campus and authenticated by Mr F. Usang of the Forestry Research Institute of Nigeria (FRIN). Voucher specimen was deposited under FHI 106921 in the Herbarium of FRIN.

### Plant preparation and extraction

Air-dried leaves, fruits, stem bark and roots (300 g each) of *S. macranthum* were ground (Hammer mill). They were extracted

with distilled methanol using Soxhlet extractor.

### Preliminary phytochemical screening

Plant extracts were screened for the presence of alkaloids, steroidal nucleus, saponin glycosides, tannins, anthraquinones, flavonoids, cyanogenetic glycosides, cardiac glycosides and reducing sugars using the methods described by Ajaiyeoba (2000) and Harborne (1984).

### Microorganisms

Clinical strains of four human pathogenic bacteria made up of two Gram positive (*S. aureus*, and *B. subtilis*) and two Gram negative bacteria (*E. coli* and *P. aeruginosa*) were used for the antibacterial assay, while for the antifungal assay, a yeast – *C. albicans* and one mould (*A. niger*) were used. All the microorganisms were obtained from the laboratory stock of the Department of Pharmaceutical Microbiology, University of Ibadan, Ibadan, Nigeria.

### Media

Nutrient broth, nutrient agar, sabourand dextrose agar (SDA), tryptone soya broth, tryptone soya agar (Oxoid laboratories, U.K) were used in the study.

### Preparation of media

#### Nutrient agar

28 g of nutrient were properly homogenized in 1 L of distilled water using a water bath maintained at 90°C. It was dispensed into 20 ml universal bottles that were sterilized by autoclave at 121°C for 15 min.

#### Sabourand dextrose agar

65 g of agar was homogenized in 1 L of distilled water on a water bath. The homogenised mixture was dispensed into 20 ml universal bottles which were sterilized by autoclave at 121°C for 15 min.

#### Nutrient broth

20 g of nutrient broth was homogenized in 1 L of distilled water and dispensed into 5 ml test tubes covered with metal caps and sterilized by autoclave.

#### Tryptone soya broth (TSB)

30 g of TSB was homogenised in 1 L of distilled water and dispensed in 10 ml test tubes covered with metal caps and sterilized by autoclave. Methanol was used in solubilising the extracts and drugs were also used as the negative control.

### Antimicrobial agents

2.5 mg/ml gentamicin sulphate, (Nicholas Laboratories Limited, England) was used as the standard reference drug for antibacterial assay while 10% (w/v) tioconazole (Pfizer Inc., New York) was used as the standard reference drug for antifungal assay.

### Preparation of bacterial and fungal cultures

From stored slopes (slant cultures), 5 ml single strength nutrient broth was inoculated. The tubes were well shaken and incubated at 37°C for 18 to 24 h for bacteria. Also, from stored slopes, 5 ml single strength tryptone soya broth was inoculated. The tubes were well shaken and incubated at room temperature for 72 h for fungi.

### Determination of antimicrobial activity

The agar well diffusion method was used to assay the extracts for antimicrobial activity (Trease and Evans, 1983; Ajaiyeoba et al., 1996). Using sterile pipettes, 0.2 ml of 1 in 100 dilution of the bacterial cultures ($2.510 \times 10^5$ cfu/ml) were added to 20 ml of the melted and cooled (45 to 50°C) nutrient agar. The contents were mixed by gentle swirling movement before being poured into sterile Petri dishes. After solidification of agar, six wells (7 mm each) were bored in each plate using an aseptic cork borer. 2000, 1000, 500, 250 and 125 mg/ml of each of the extracts reconstituted in methanol were filled into the wells with the aid of Pasteur pipettes. Diameters of zones of inhibition were determined as an indication of activity after incubating the plates at 37°C for 24 h for bacteria and at 25°C for 72 h for fungi. 90% methanol (1 ml) was included in each plate as negative control while gentamicin (2.5 mg/ml) and tioconazole at 10% (w/v) were used as positive control for bacteria and fungi, respectively.

## RESULTS AND DISCUSSION

The extraction of *S. macranthum* leaves, fruits, stem bark and roots with methanol gave yields of 10.67, 3.33, 2.17 and 3.00% respectively. The results of the phytochemical screening indicated the presence of the alkaloids, the steroidal nucleus, saponin glycosides, flavonoids, reducing sugars, anthraquinones, tannins and cardiac glycosides. The presence of free and combined anthraquinones were indicated in the fruit and stem bark extracts and were absent in both the leaves and roots. The abundance of secondary metabolites followed the order: fruits>stem bark>roots>leaves> (Table 1). For the antimicrobial activity, the diameters of zones of inhibition were measured and recorded (Table 2).

The leaf, stem bark, roots and fruit extracts of *S. macranthum* exhibited variable antibacterial and antifungal activities. However, the bacterial strains were more susceptible to the extracts than the fungal strains in the assay (Table 2). The leaf and stem bark extracts displayed high antibacterial activity at 1.0 g/ml against *S. aureus* and *P. aeruginosa*, while the root extract showed similar effect to *B. subtilis* and *P. aeruginosa* and the fruit extract showed similar antibacterial activity to *P. aeruginosa* only when compared to the reference antibacterial drug, gentamicin at 2.5 mg/ml. *E. coli* was least sensitive in the antibacterial assay with high inhibitory activity at 2.0 g/ml. It was also observed that the extracts were more active against *P. aeruginosa,* which is naturally resistant to antibacterial agents (Ajaiyeoba et al., 2003) than *E. coli* at 1.0 mg/ml. *C. albicans* and *A. niger* were mildly inhibited even at 2.0 g/ml. It has been reported that the methanol fruit extract of *Solanum*

**Table 1.** Preliminary phytochemical screening of *S. macranthum* extracts.

| Test | Leaf | Stem bark | Root | Fruit |
|---|---|---|---|---|
| Alkaloids | + | + | + | ++ |
| Steroidal nucleus | + | ++ | ++ | ++ |
| Saponin glycosides | + | ++ | ++ | + |
| Cardiac glycosides | + | ++ | ++ | ++ |
| Cyanogenetic glycosides | _ | _ | _ | _ |
| Anthraquinones (free) | _ | + | _ | + |
| Anthraquinones (combined) | _ | ++ | _ | ++ |
| Reducing Sugars | _ | ++ | + | ++ |
| Tannins | _ | _ | _ | ++ |
| Flavonoids | _ | ++ | + | ++ |

(-), Absent; (+), fairly present; (++), abundant.

**Table 2.** Antimicrobial activity of *S. macranthum* extracts.

| Extract | Concentration (mg/ml) | *S. aureus* | *B. subtilis* | *E. coli* | *P. aeruginosa* | *C. albicans* | *A. niger* |
|---|---|---|---|---|---|---|---|
| Leaf | 62.5 | - | - | - | - | - | - |
| | 125 | 10±0.2 | 10±0.2 | 10±0.5 | 12±0.2 | - | - |
| | 250 | 12±0.4 | 12±0.3 | 12±0.2 | 14±0.2 | 10±0.4 | 10±0.5 |
| | 500 | 16±0.3 | 16±0.2 | 14±0.4 | 18±0.3 | 12±0.3 | 12±0.4 |
| | 1000 | 20±0.3 | 18±0.4 | 18±0.3 | 20±0.3 | 14±0.2 | 14±0.5 |
| | 2000 | 24±0.4 | 22±0.5 | 20±0.4 | 26±0.2 | 16±0.5 | 18±0.3 |
| Fruits | 62.5 | - | - | - | - | - | - |
| | 125 | 10±0.3 | 10±0.2 | 12±0.2 | 12±0.3 | - | - |
| | 250 | 12±0.3 | 12±0.2 | 14±0.3 | 14±0.2 | 10±0.3 | 10±0.2 |
| | 500 | 14±0.2 | 14±0.4 | 16±0.4 | 16±0.3 | 12±0.2 | 12±0.3 |
| | 1000 | 18±0.3 | 16±0.3 | 18±0.2 | 20±0.3 | 14±0.2 | 14±0.3 |
| | 2000 | 20±0.2 | 22±0.2 | 22±0.3 | 24±0.2 | 16±0.2 | 18±0.5 |
| Stem bark | 62.5 | - | - | - | - | - | - |
| | 125 | 12±0.3 | 10±0.3 | 10±0.2 | 12±0.2 | - | - |
| | 250 | 14±0.4 | 12±0.3 | 12±0.3 | 14±0.2 | 10±0.2 | 10±0.3 |
| | 500 | 18±0.2 | 14±0.2 | 14±0.3 | 16±0.4 | 12±0.4 | 12±0.3 |
| | 1000 | 20±0.3 | 18±0.2 | 18±0.5 | 20±0.4 | 16±0.2 | 14±0.2 |
| | 2000 | 22±0.3 | 24±0.3 | 22±0.2 | 24±0.2 | 18±0.4 | 16±0.2 |
| Roots | 62.5 | - | - | - | - | - | - |
| | 125 | 12±0.3 | 10±0.2 | 10±0.4 | 12±0.2 | - | - |
| | 250 | 14±0.2 | 14±0.2 | 14±0.3 | 14±0.5 | 10 | 10 |
| | 500 | 16±0.4 | 16±0.2 | 16±0.2 | 16±0.3 | 12±0.4 | 12±0.2 |
| | 1000 | 18±0.5 | 20±0.2 | 18±0.3 | 20±0.3 | 14±0.2 | 14±0.3 |
| | 2000 | 20±0.3 | 22±0.3 | 20±0.4 | 26±0.2 | 16±0.3 | 18±0.4 |
| **Controls** | | | | | | | |
| 1 ml 90% methanol | - | - | - | - | - | - | - |
| Gentamicin sulphate | 2.5 mg/ml | 32±0.3 | 30±0.2 | 32±0.5 | 34±0.3 | NT | NT |
| Tioconazole | 10% w/v | NT | NT | NT | NT | 20±0.4 | 22±0.2 |

NT= not tested; (-) = no inhibition (< 10 mm). Diameter of zones of inhibition (mm) are expressed as means and standard errors on means.

*torvum* exhibited antimicrobial activities against both human and animal clinical strains (Walker and Edwards, 1999). The significance of research in plants extends our knowledge of their botany, their constituents, their pharmacological activity and their ethnomedicinal value so that they can be used more effectively in the treatment and prevention of diseases. Ethnomedicinally, leaves of *S. torvum* have been used for the treatment of wound infections, coughs, sore throat while, *S. erianthum* is reported to have diuretic, purgative properties and also is active in the treatment of venereal diseases and leprosy. This infact points to the roles of the inferenced secondary metabolites in the phytochemical analysis.

The presence of alkaloids, flavonoids and saponin glycosides may be responsible for the observed antimicrobial effects; though this activity may be said to be weak but there is the likelihood of synergetic activity of these observed secondary metabolites.

**REFERENCES**


Ajaiyeoba EO (2000). Phytochemical and antimicrobial studies *Gynandropsis gynandra* and *Buchholzia coriaceae* extracts. Afr. J. Biomed. Res. 3: 161-165.

Ajaiyeoba EO, Okogun J (1996).Anthelmintic activity of a root extract of Ritchica capparoides var. longipedicellataPhytother. Res. 10: 436-437.

Ajaiyeoba EO, Onocha PA, Nwozo SO, Sama W (2003). Anthelmintic-activities of chloroform and methanol extracts of *Buchholzia coriacea*engler seed. Fitoterapia, 3: 142-144.

Burkill HM (2000). The Useful Plants of West Tropical Africa, Royal Botanic Gardens, Kew. 5: p. 136.

Chan KF, Muko KN, Oboegbulem SI (2000). Antimicrobial activity of methanolic extract of Solanum torvum fruit. Fitoterapia, 71: 187-189.

Dabur R, Sharma GL (2002). Antifungal potential of Indian medicinal plants. J. Ethnopharm. 80: 193-197.

Dabur R, Singh H, Chhillar AK, Ali M, Sharma GL (2004). Apoptosis inducing activity of steroidal constituents from Solarium xanthocarpum and Asparagus racemosus. Fitoterapia, 75: 389-391.

Fayez MBE, Saleh AA (1967). The steroidal alkaloids of Solanum wrightii, Benth. Phytochem. 6:433-436

Harborne JB (1984). Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis Chapman and Hall.

Hardman R (1969). Pharmaceutical products from plant steroids. Trop. Sci. 11: 196-228

http://www.toptropical.com/catalog/SOLANUM.

MACRANTHUM. http.htm. ,http://www.rareflora.com. (May 15, 2005).

Trease GE, Evans WC (1983). Trease and Evans' Pharmacognosy 12th Edition, Baillere Tindall, Oval Road, London, England, pp. 245-265, 544-636

Walker R, Edwards C (1999). Clinical Pharmacy and Therapeutics, 2nd ed. Churchill Livingstone, p. 497.