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Identification and pharmacological properties of coastal plants from Barangay Diguisit, Baler, Aurora

Zedrick A. Ventura[1], Diana C. Castillo[*2,3], Evaristo A. Abella[2,3]

[1]*Department of Biological Sciences, College of Science, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines*

[2]*Faculty, Department of Biological Sciences, College of Science, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines*

[3]*Biodiversity Conservation Laboratory, Interactive Laboratory, Department of Biological Sciences, College of Science, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines*

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Abstract

This study was conducted to screen the pharmacological properties of the different coastal plants located along coastal areas of Diguisit, Baler, Aurora. Six coastal plants were collected and were identified as *Dracaena fragrans*, *Pueraria montana* var. *lobata*, *Sphagneticola trilobata*, Urticaceae, *Nephrolepis cordifolia*, and Pandanaceae. Ethanol extracts of plants were evaluated for antibacterial properties against *S. aureus* and *E. coli* using disc diffusion method. Positive results were revealed in *S. aureus* both in 24 and 48 hours as zones of inhibitions were manifested. *S. trilobata* and *P. montana* var. *lobata* has the largest zone of inhibition. On the other hand, only the *P. montana* var. *lobata*, *S. trilobata*, and Urticaceae showed positive result against *E.coli* at 24 hours. At the 48th hour of incubation, a decrease in zones of inhibition was observed. Antioxidant activity assay was evaluated in 2,2-diphenyl-1-picrylhydrazyl (DPPH), trolox equivalent. All of the coastal plants collected showed antioxidant activity; Pandanaceae and *S. trilobata* were recorded with the highest antioxidant activity. The results in test for antibacterial properties and antioxidant activities suggested that the coastal plants collected had the potential for pharmacological properties.

***Corresponding Author:** Diana C. Castillo ✉ dccastillo@clsu.edu.ph

Introduction

Higher plants have been described as chemical factories that are capable of synthesizing unlimited number of highly complex and unusual chemical substances. The World Health Organization (2004) estimated that 80% of the people in developing countries of the world rely on traditional medicine for their primary health care needs, and about 85% of traditional medicine involves the use of plant extracts. This means that about 3.5 to 4 billion people in the world rely on plants as sources of drugs. Pharmacology, by definition, is the branch of biology concerned with the study of drug action which exerts a biochemical or physiological effect on the cell, tissue, organ, or organism (Vallance & Smart, 2006). If substances have medicinal properties, they are considered pharmaceuticals (Finkel *et al.,* 2009).

The Philippines is high in terms of plant diversity that an estimated 30-40% of these plants is endemic to the country and found nowhere else in the world (Amoroso, 2012). The municipality of Baler in Aurora is present with coastal areas. Beaches in Baler, Aurora were abundantly rearing with different coastal plants growing along the shore and rock formations.

The Philippine Government RA No. 8423 or the "Traditional and Alternative Medicine Act (TAMA) of 1997" was declared and stated to improve the quality and delivery of health care services to the Filipino people. One of the objectives is to promote and advocate the use of traditional, alternative, preventive and curative health care modalities that have been proven safe, effective, cost effective and consistent with government standards on medical practice. This study of the different coastal plants located along the beaches of Barangay Diguisit, Baler, Aurora was evaluated for its pharmacological properties through antibacterial properties and antioxidant analysis.

Materials and methods

Plant Materials

Different coastal plants from Diguisit, Baler, Aurora were collected and authenticated. For the samples needed for extraction, the healthy and undamaged leaf parts of the plants were collected by handpicking before assaying. The leaves were rinsed with water and placed in a clean, separate, and sealed plastic bags until extraction process.

For the samples needed for authentication, vegetative and reproductive part of the plants were collected and instantly washed with ethyl alcohol before placing in clean plastic bags.

Plant Extraction

Plant samples were cut into small pieces for air-drying and were powderized. Ethanolic extraction and concentration using rotary evaporation was done in the Rice Chemistry and Food Science Division, Philippine Rice Research Institute, Nueva Ecija. The extracts obtained were stored in a refrigerator until use.

Evaluation of Antibacterial Property

Test Microorganisms

The pure culture of the gram positive *Staphylococcus aureus* and the gram negative *Escherichia coli* bacteria were provided by the Department of Biological Sciences, College of Arts and Sciences, Central Luzon State University.

Preparation of Bacterial Suspension

Ten milliliters of nutrient broth (NB) was prepared and dispensed into test tubes and sterilized on an autoclave at 121°C, 15 psi for 15 mins. A loopful of the two bacteria was inoculated on the prepared nutrient broth. The suspension was then incubated at sanitize room temperature for 6 hours before adjusting the turbidity using 0.5mcFarland Turbidity Standard.

Preparation of Culture Media

The Mueller-Hinton Agar (MHA) was prepared based on the instruction given. The MH agar powder was boiled in distilled water until totally dissolved in a flask. It was sterilized in an autoclave at 121°C, 15 psi for 15 mins, then cooled in a water bath at 45-50°C. Twenty milliliters of the prepared medium was aseptically pour plated into sterilized petri plates in a clean and sanitize chamber.

Antibacterial Activity Assay

Antibacterial activity was tested by disc diffusion method in which sterilized 6mm filter paper disc was used. About 100 µL of the bacteria was pipetted into the media and swabbed with sterile cotton swabs. Furthermore, the filter paper discs were soaked with 0.01mL of the streptomycin, ethanol, and the different ethanol plant extracts. Streptomycin and the ethanol solvent were used as the positive and negative control, respectively. Plates were incubated at room temperature (37°C) for 24 and 48 hours.

Antioxidant Activity Assay

The plant extract samples were analyzed in Rice Chemistry and Food Science Division, Philippine Rice Research Institute, Science City of Muñoz, Nueva Ecija, Philippines for the determination of their antioxidant properties in terms of DPPH Radical Scavenging Assay in trolox equivalent.

Results and discussion

Coastal Plant Collection Sites

Fig. 1 showed the map of the coordinates of the collection sites of the coastal plants. Five 10 x 10 m quadrat were laid in the area in the coast of Barangay Diguisit, Baler, Aurora. Table 1 showed the coastal plants and the collection sites where they can be found growing. Some of the plants can also be found growing in other collection sites (Fig. 2).

Fig. 1. Map of the coordinates of the collection sites of coastal plants; (A) Collection site 1, (B) Collection site 2, (C) Collection site 3, (D) Collection site 4, (E) Collection site 5.

Collection site 1 was an area of a rocky-soil and sand substratum located about 4 m from the water. *D. fragrans*, *P. montana* var. *lobata* and Urticaceae were collected in this area.

Table 1. Collection site of the collected coastal plants.

Treatments	Collection Sites					Total
	1	2	3	4	5	
Dracaena fragrans	✓				✓	2
Pueraria montana var. *lobata*	✓			✓	✓	3
Sphagneticola trilobata		✓				1
Urticaceae	✓	✓				2
Nephrolepis cordifolia					✓	1
Pandanaceae			✓			1

Fig. 2. Collection sites of the coastal plants; (A) Collection site 1, (B) Collection site 2, (C) Collection site 3, (D) Collection site 4, and (E) Collection site 5.

Collection site 2 has a sandy-soil substratum wherein *S. trilobata* invades most of the area along with the Urticaceae that grows in the area.

The 3rd collection site was an area of sand substratum with vastly growing Pandanaceae along with palms and trees.

The 4th collection site was located near a waterfall with large boulders of rocks. *P. montana* var. *lobata* was found creeping in this area. It was a soil-rocky substratum and located about 3 m from the water at the coast.

Collection site 5 was located in a more elevated area. The plants collected in this area were *N. cordifolia*, *D. fragrans*, Pandanaceae, *P. montana* var. *lobata*, and some trees.

Authentication of Coastal Plants

A total of 6 coastal plants belonging to 6 families, 4 genera, 4 species and 1 variety were collected and recorded from the coastal areas of Barangay Diguisit, Baler, Aurora. These were Cornstalk Dracaena (*Dracaena fragrans*), East Asian Arrowroot (*Pueraria montana* var. *lobata*), Trailing Daisy (*Sphagneticola trilobata*), Urticaceae, Sword Fern (*Nephrolepis cordifolia*), and Pandanaceae.

1. *Dracaena fragrans* (L). Ker Gawl (Fig. 3)

Fig. 3. *Dracaena fragrans.*

Residency: Introduced, Cultivated
IUCN Status: Least Concern
Division: Tracheophyta
Class: Magnoliopsida
Order**:** Asparagales
Family: Asparagaceae
Genus: *Dracaena*
Species: *D. fragrans*
Common Name**:** Cornstalk Dracaena

Description

The collected *D. fragrans* grows in a rocky-soil substratum with little sands; some also grows in a loamy soil with dried leaves. This plant can be found growing alone or with the other plants beside.

Cornstalk Dracaena or *D. fragrans* is a slow growing flowering shrub, usually multi stemmed at the base, mature specimens reaching 15 m or more tall with a narrow crown of usually slender erect branches. Stems may reach up to 30cm diameter on old plants. The leaves are glossy green, lanceolate, 20–150cm long and 2–12cm wide; small leaves are erect to spreading, and larger leaves usually drooping under their weight (Huxley, 1992). The flowers are produced in panicles 15–160cm long, the individual flowers are 2.5cm diameter, with a six-lobed corolla, pink at first, opening white with a fine red or purple central line on each of the 7–12mm lobes; they are highly fragrant, and popular with pollinating insects. The fruit is an orange-red berry 1–2cm diameter, containing several seeds (Baza Mendonça & dos Anjos, 2005).

2. *Pueraria montana* var. *lobata* (Willd.) Maesen & S.M. Almeida ex Sanjappa & Predeep (Fig. 4)

Fig. 4. *Pueraria montana* var. *lobate*

Residency: Native
IUCN Status: Least Concern
Division: Tracheophyta
Class: Magnoliopsida
Order: Fabales
Family: Fabaceae
Genus: *Pueraria*
Species: *P. montana*
Variety: *lobata*
Common Name: East Asian Arrowroot

Description

The collected *P. montana* var. *lobata* was collected from a soil-rocky substratum. It was found crawling in large boulders.

East Asian Arrowroot or *P. montana* var. *lobata* is a seasonal climbing plant, growing high where suitable surfaces (trees, cliffs, walls) are available, and also

growing as ground cover where there are no vertical surfaces. It is a perennial vine with tuberous roots and rope-like, dark brown stems to 20 m long. It grows up to 20 m per year and can achieve a growth height of 30 m (Forseth Jr. & Innis, 2004). Flowers are reddish-purple and yellow, fragrant, similar to pea flowers, about 20-25mm wide and are produced at the leaf axis in elongated racemes about 20cm long. The flowering period extends from July through October. The fruit is a flat hairy pod about 8cm long with three seeds (Jewett *et al*., 2003).

3. *Sphagneticola trilobata* (L.) Pruski (Fig. 5)

Fig. 5. *Sphagneticola trilobata*.
Residency: Introduced, Cultivated
IUCN Status: Least Concern
Division: Magnoliophyta
Class: Magnoliopsida
Order: Asterales
Family: Asteraceae
Genus: *Sphagneticola*
Species: *S. trilobata*
Common Name: Trailing Daisy

Description

The collected *S. trilobata* grows in a sandy-soil with dried leaves. They grow together closely invading most of the area.

Trailing Daisy or *S. trilobata* is a plant in the Heliantheae tribe of the Asteraceae (sunflower) family. It has a very wide ecological tolerance range, but grows best in sunny areas with well-drained, moist soil at low elevations. It is a spreading, mat-forming perennial herb up to 30cm in height. It has rounded stems up to 40cm long, rooting at nodes and with the flowering stems ascending. Leaves are fleshy, hairy, 4–9cm long and 2–5cm wide, serrate or irregularly toothed, normally with pairs of lateral lobes, and dark green above and lighter green below. Peduncles are 3–10cm long; involucres are campanulate to hemispherical, about 1cm high; chaffy bracts are lanceolate, rigid.

The flowers are bright yellow ray florets of about 8-13 per head, rays are 6-15mm long; disk-corollas 4-5mm long. The pappus is a crown of short fimbriate scales. The seeds are tuberculate achenes, 4–5mm long. Propagation is mostly vegetatively as seeds are usually not fertile (Gunasekara, 2009).

4. Urticaceae Family Juss, 1789 (Fig. 6).

Fig. 6. Urticaceae Family.
Residency: Native
IUCN Status: Least Concern
Division: Tracheophyta
Class: Magnoliopsida
Order: Rosales
Family: Urticaceae

Description

The collected Urticaceae grows in a sand substratum with dried leaves. They grow in clusters, occupying a large part of the quadrat.

Urticaceae is a family, the nettle family, of flowering plants. The family name comes from the genus *Urtica*. The Urticaceae include a number of well-known and useful plants, including nettles in the genus *Urtica*, ramie (*Boehmeria nivea*), māmaki (*Pipturus albidus*), and ajlai (*Debregeasia saeneb*). According to the database of the Royal Botanic Gardens, the family includes about 2625 species, grouped into 53 genera. The largest genera are *Pilea* (500 to 715 species), *Elatostema* (300 species), *Urtica* (80 species), and *Cecropia* (75 species). *Cecropia* contains many myrmecophytes (Chomicki & Renner, 2015). Urticaceae species can be found worldwide, apart from the Polar Regions.

5. *Nephrolepis cordifolia* (L.) C. Presl (Fig. 7).

Fig. 7. *Nephrolepis cordifolia*.

Residency: Native
IUCN Status: Least Concern
Division: Pteridophyta
Class: Polypodiopsida/Pteridopsida
Order: Polypodiales
Family: Nephrolepidaceae
Genus: *Nephrolepis*
Species: *N. cordifolia*
Common Name: Sword Fern

Description

The collected *N. cordifolia* was found in a more elevated area of soil and sand substratum. They were found growing scattered throughout the area.

Sword Ferns (*N. cordifolia*) are unique in bearing sporangia with a vertical annulus interrupted by the stalk and stomium. The sporangia are born on stalks 1–3 cells thick and are often long-stalked. The sporangia do not reach maturity simultaneously. Many groups in the order lack indusia, but when present, they are attached either along the edge of the indusium or in its center (Smith *et al.*, 2006). Gametophytes are green, usually heart-shaped, and grow at the surface (Christenhusz & Chase, 2014).

6. Pandanaceae Family R. Br. (Fig. 8).

Fig. 8. Pandanaceae Family.

Residency: Native, Cultivated
IUCN Status: Near Threatened
Division: Tracheophyta
Class: Magnoliopsida
Order: Pandanales
Family: Pandanaceae

Description

The collected Pandanaceae is a pineapple-like plant having elongated leaves with thorns on its edges. Numerous of them can be found growing in a certain area.

Pandanaceae is a family of flowering plants native to the tropics and subtropics of the Old World, from West Africa through the Pacific. It contains 982 known species in five genera. Pandanaceae includes trees, shrubs, lianas, vines, epiphytes, and perennial herbs.

Stems may be simple or bifurcately branched, and may have aerial prop roots. The stems bear prominent leaf scars. The leaves are very long and narrow, sheathing, simple, undivided, with parallel veins; the leaf margins and abaxial midribs are often prickly. The plants are dioecious.

The inflorescences are terminally borne racemes, spikes or umbels, with subtended spathes, which may be brightly colored.

The flowers are minute and lack perianths. Male flowers contain numerous stamens with free or fused filaments. Female flowers have a superior ovary, usually of many carpels in a ring, but may be reduced to a row of carpels or a single carpel. Fruits are berries or drupes, usually multiple.

Evaluation of Antibacterial Property

This study elucidates the antibacterial property of the different coastal plants. Table 2 presents the data of zone of inhibition of the different coastal plant ethanol extracts against *S. aureus* incubated at 24 and 48 hours (Fig. 9).

After 24 hours of incubation, it was noted that all coastal plant extracts manifested zone of inhibition against *S. aureus*. Out of the six plant extracts, *S. trilobata* was recorded to have the highest mean zone of inhibition with 8.90mm, followed by *P. montana* var. *lobata* and Urticaceae having 8.56mm and 5.32mm, respectively. Statistical analysis would show that *S. trilobata*, *P. montana* var. *lobata*, and Urticaceae were comparable to each other while.

Urticaceae was not significantly different from Pandanaceae, *N. cordifolia*, and *D. fragrans*. As expected, streptomycin yielded the wildest zone of inhibition with 27.98mm. Ethanol on the other hand did not produce zone of inhibition against *S. aureus*.

The same trend was noted after 48 hours of incubation except for a decrease in zone of inhibition in all extracts and the (+) positive control.

Table 2. Zone of inhibition by the coastal plant ethanol extracts against *S. aureus* after 24 and 48 hours of incubation.

Treatments	Mean Zone of Inhibition	
	24 hours	48 hours
1. Streptomycin	27.98 + 3.38^{a}	23.99 + 2.53^{a}
2. Ethanol	0.00 + 0.00^{d}	0.00 + 0.00^{d}
3. *Dracaena fragrans*	1.89 + 1.77^{cd}	1.22 + 1.07^{cd}
4. *Pueraria montana* var. *lobata*	8.56 + 0.84^{b}	6.34 + 1.03^{b}
5. *Sphagneticola trilobata*	8.90 + 4.03^{b}	6.82 + 3.69^{b}
6. Urticaceae	5.32 + 1.62^{bc}	3.73 + 1.85^{bc}
7. *Nephrolepis cordifolia*	1.36 + 1.25^{cd}	0.48 + 0.83^{cd}
8. Pandanaceae	2.33 + 0.79^{cd}	0.77 + 0.40^{cd}

*Values with the same letter are not significantly different at P<0.05 according to DMRT

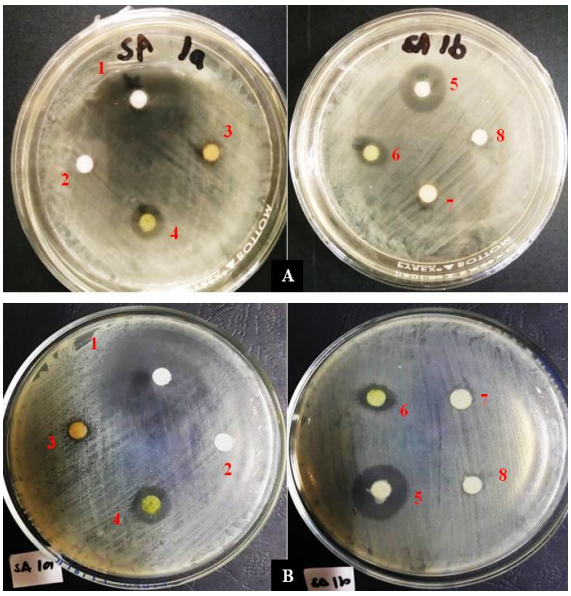

Fig. 9. Zones of inhibition of coastal plant ethanol extracts against *S. aureus* incubated for (A) 24 hours and (B) 48 hours; (1) Streptomycin, (2) Ethanol, (3) *Dracaena fragrans*, (4) *Pueraria montana* var. *lobata*, (5) *Sphagneticola trilobata*, (6) Urticaceae, (7) *Nephrolepis cordifolia*, and (8) Pandanaceae.

Table 3 presents the data of zone of inhibition of the different coastal plant ethanol extracts against *E. coli* incubated at 24 and 48 hours (Fig. 10).

After 24 hours of incubation, it was noted that only three of the coastal plant extracts possessed zone of inhibition against *E. coli*. Out of the three plant extracts, *P. montana* var. *lobata* was recorded to have the highest mean zone of inhibition with 7.69mm, followed by *S. trilobata* and Urticaceae having 3.95mm and 1.72mm, respectively.

Statistical analysis would show that *P. montana* var. *lobata* was significantly different to *S. trilobata* and Urticaceae, while *S. trilobata* and Urticaceae were comparable to each other. However, Urticaceae was not significantly different from Pandanaceae, *N. cordifolia*, and *D. fragrans*, and the ethanol. As expected, streptomycin yielded the wildest zone of inhibition with 26mm. Ethanol on the other hand did not produce zone of inhibition against *S. aureus*. After 48 hours of incubation, there were a decrease in zone of inhibition in all extracts and the (+) positive control. The zone of inhibition of the Urticaceae was completely gone. It was observed that *P. montana* var. *lobata* and *S. trilobata* were comparable to each other while *S. trilobata* was not significantly different from *D. fragrans*¸ Urticaceae, *N. cordifolia*, and Pandanaceae.

Table 3. Zone of inhibition by the coastal plant ethanol extracts against *E. coli* after 24 and 48 hours of incubation

Treatments	Mean Zone of Inhibition	
	24 hours	48 hours
1. Streptomycin	26.00 + 0.96^{a}	21.96 + 2.19^{a}
2. Ethanol	0.00 + 0.00^{d}	0.00 + 0.00^{c}
3. *Dracaena fragrans*	0.00 + 0.00^{d}	0.00 + 0.00^{c}
4. *Pueraria montana* var. *lobata*	7.69 + 4.14^{b}	4.99 + 3.30^{b}
5. *Sphagneticola trilobata*	3.95 + 1.84^{c}	2.54 + 1.50^{bc}
6. Urticaceae	1.72 + 0.99^{cd}	0.00 + 0.00^{c}
7. *Nephrolepis cordifolia*	0.00 + 0.00^{d}	0.00 + 0.00^{c}
8. Pandanaceae	0.00 + 0.00^{d}	0.00 + 0.00^{c}

*Values with the same letter are not significantly different at P<0.05 according to DMRT

D. fragrans showed antibacterial properties against *S. aureus* and not in *E. coli*. Narender *et al.*, (2017), said that the antibacterial activity of *D. fragrans* is often attributed to its antioxidant properties due to the presence of flavonoids.

As for the of *P. montana* var. *lobata*, it was observed that the effects were stronger against *S. aureus* than in *E. coli*. Similar results were obtained by Chung & Chen (2008). *S. trilobata* showed a positive result against the two bacteria pathogens. Inhibition is larger in *S. aureus* and antibacterial component were already present in the plant (Maldini *et al.*, 2009).

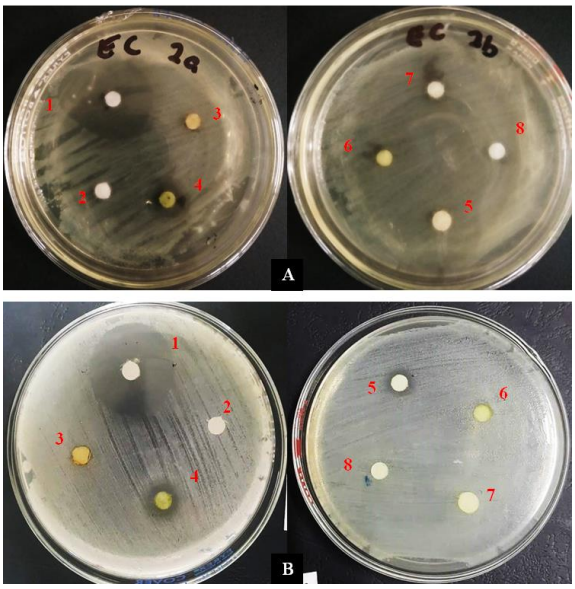

Fig. 10. Zones of inhibition of coastal plant ethanol extracts against *E. coli* incubated for (A) 24 hours and (B) 48 hours; (1) Streptomycin, (2) Ethanol, (3) *Dracaena fragrans*, (4) *Pueraria montana* var. *lobata*, (5) *Sphagneticola trilobata*, (6) Urticaceae, (7) *Nephrolepis cordifolia*, and (8) Pandanaceae.

The antibacterial property of the Urticaceae showed minimum growth of inhibition especially in *E.coli*, the same result from the study of Körpe *et al.* (2013). *N. cordifolia* exhibits a minimum growth as well in *S. aureus* and negative in *E. coli*. In a same study conducted by Upreti and Gyawali (2015), no zones of inhibition resulted in their gram positive and negative bacteria. For the Pandanaceae, the result is only at minimum inhibition in *S. aureus* and in the study of Andriani and Mohamad, (2015) no zones of inhibition were shown. The collected plant extracts were proven to have antibacterial properties against the two pathogens. All coastal plant extracts were effective and *S. trilobata*, *P. montana* var. *lobata*, and Urticaceae were very effective against the *S. aureus*. On the other hand, *S. trilobata* and *P. montana* var. *lobata* were also effective against *E. coli*.

Determination of Antioxidant Activity

Table 4 presents the data of the antioxidant activity of the different coastal plants evaluated in DPPH, trolox equivalent. Scavenging free radicals is the basis and assessment of an antioxidant assay. The free radical used in this study is DPPH.

DPPH is a stable free radical as a result of the delocalization of electrons all over the molecule. It was noted that all coastal plants exhibited antioxidant activities. Among the six coastal plants, Pandanaceae was recorded to have the DPPH value with 4.90, followed by *S. trilobata* and *N. cordifolia* having 4.36 and 3.89, respectively. Statistical analysis would show that all the coastal plants – Pandanaceae, *S. trilobata*, *N. cordifolia*, *D. fragrans*, *P. montana* var. *lobata*, and Urticaceae were comparable to each other.

The ethanol extract of *Dracaena sp.* contains glycoside and flavonoid and its antioxidant activity is due to the reducing power ability (Chinaka *et al.*, 2013). Preliminary chemical group identification revealed the presence of alkaloids, glycosides, steroids, terpenoids, tannins and reducing sugars important secondary metabolites (Sultana, 2012). *P. montana* var. *lobata* contains more amounts of puerarin and daidzein (Cherdshewasart *et al.*, 2007), this explains why this plant exhibits antioxidant activity.

Limited literature about the *S. trilobata* antioxidant activity is available. Bhargava *et al.*, (1974), reported the pharmacological and antioxidant properties of the plant. This attributes to the presence of natural products in the form of flavonoids, terpenoids and steroids. The studies of Subramonium *et al.*, (1999) inferred the use of the plant in the treatment of liver disorders, due to its efficient antioxidant property owing to the presence of isoflavonoids. In a study of Chahardehi *et al.*, (2008), species under Urticaceae will show high DPPH radical scavenging percentage by ethanol extracts.

Table 4. Antioxidant Activity of the Coastal Plants in DPPH, Trolox Equivalent.

Plant Samples	DPPH (Trolox eq.)
1. *Dracaena fragrans*	2.70 + 0.08^{d}
2. *Pueraria montana* var. *lobata*	1.94 + 0.04^{e}
3. *Sphagneticola trilobata*	4.36 + 0.19^{b}
4. Urticaceae	0.51 + 0.02^{f}
5. *Nephrolepis cordifolia*	3.89 + 0.10^{c}
6. Pandanaceae	4.90 + 0.17^{a}

*Values with the same letter are not significantly different at P<0.05 according to DMRT.

The antioxidant properties of *N. cordifolia* have not been determined extensively in other studies. However, the antioxidant properties of phytochemicals such as phenolic, coumarin, hydroxycinnamic acid and proanthocyanidin have been mentioned in other studies (Kostova *et al.*, 2011; Pietta, 2000). The antioxidant capacity of the Pandanaceae extract may partly be from the flavonoids it contains. Flavonoids are low molecular weight polyphenolic compounds that are abundant in nature. Many flavonoids, such as kaempherol, quercetin, luteolin, myricetin, eridictyol, and catechin, have been shown to have antioxidant, anti-inflammatory, antiallergic, anticancer, and antihemorrhagic properties (Hanasaki *et al.*, 1994). The alkaloid and saponin content of the extract may also play a role in its antioxidant activities since some both saponins and alkaloids have been shown to exhibit antioxidant properties (Pitzschke *et al.*, 2006).

Conclusion

All of the coastal plants collected exhibits antibacterial properties but the zones of inhibition differ in the test organisms. There were inhibition in *S. aureus* from all the extracts, and only 3 extracts in the *E. coli*. The main difference between the two is the structure of their cell wall which changes their susceptibility to different antibiotics. Gram positive organism lacks an outer membrane; this facilitates access of cell-wall active antibiotics to their site of action. In gram negative bacteria, antibiotics have to traverse the LPS layer via porin proteins. Moreover, all of these collected coastal plants contain antioxidant activities. It was discussed that these antioxidant chemicals may or greatly contributes to the positive result in the antibacterial tests. It is also concluded that even if the amount of trolox equivalent in DPPH is high or not, it still exhibits antibacterial properties for certain bacteria.

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