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Phytochemical evaluation of various parts of *Dracaena arborea* Link. and *Dracaena mannii* Bak.

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Phytochemical evaluation of leaves, stems and roots of *Dracaena arborea* (Link) and *Dracaena mannii* (Bak) present in southeastern Nigeria was carried out, to determine their taxonomical data with regards to their phytochemicals contents (flavonoid, saponin, tannin, cyanide, lectin, phytate and calcium oxalate) using standard methods. The results show varying quantities of the phytochemicals in the leaves, stems and roots of the two *Dracaena* species with some parts lacking some of the phytochemicals. The highest quantity of the phytochemicals was contained in the leaves of both species when compared to other parts respectively. The result also revealed no significant statistical difference in the phytochemistry of the two *Dracaena* species. The implication is that the two species are closely related and this justified their placement in the same genus *Dracaena* while the slight differences between them support their separation into different species. The result also indicated that the two species could be used in ethnomedicine for the treatment of diseases. In addition, these parts could be the possible sources of these phytochemicals.

Key words: *Dracaena arborea, Dracaena mannii*, phytochemicals.

INTRODUCTION

Dracaena consists of about 40 species (Waterhouse, 1987; Venter, 1996), and to Huxley (1992), it consists of 50 species. Sharma (1993) and Dutta (2003) described it as a genus of about 150 species. The genus was first described by Linnaeus in 1767. Some species of *Dracaena* include *Dracaena fragrans, D. surculosa, D. draco, D. marginata, D. arborea, D. goldiana, D.sanderina, D. deremensis, D. reflexa, D. mannii* etc. *Dracaenas* are either shrubs or trees and are divided into two broad groups based on their growth habits- tree *Dracaenas* and shrubby *Dracaenas*. Tree *Dracaena*s include *Dracaena americana* (Central American dragon tree), *D. draco* (Canary Islands draco tree), *D. marginata, Dracaena mannii* etc. while shrubby *Dracaenas* include *D. aletriformis, D. bicolor, D. cincta, D. concinna*, etc.(Waterhouse, 1987). *Dracaenas* are used as ornamentals, medicinal plants, in photo engraving, in research, as hedge plants, colourants, etc. In Europe and Canada, they are cultivated

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Figure 1. (a) *D. mannii*. **(b)** *D. arborea.*

and sold as ornamentals, (Huxley, 1992). *Dracaena arborea* Link. and *Dracaena mannii* Bak. which are commonly found in South eastern Nigeria are the points of interest in this research.

To classify plants, taxonomists make use of morphology, phylogeny, physiology, phytochemistry, anatomy, cytology, palynology etc. as taxonomic lines of evidence to determine their similarities and differences in order to group them into various taxa. Any data which show differences from species to species are of taxonomic significance and thus constitute part of the information or evidences which may be used by taxonomists (Stace, 1980). Phytochemicals are used in determining the relationship among taxa of different categories. Some of the major classes of the chemical evidence include flavonoids, alkaloids, amino acids, fatty acids, carotenoids, aromatic compounds etc (Sharma, 1993). Cronquist (1981) cited the following examples to indicate the use of chemistry in solving taxonomic problems: Caryophyllales produce betalain and not anthocynins; Polyoniales produce anthocynins and not betaains; Juglandales are aromatic plants while Fagales are non-aromatic; highly aromatic compounds are found in Lamiaceae; alkaloids are very common in Solanaceae; Sapindaceae have plenty of tannins.

Determination of these differences and similarities with regards to phytochemistry of the two species based on the outcome of the study were the objectives of this research.

MATERIALS AND METHODS

Sources of materials

Leaves, stems, fruits and roots, of *Dracaena* species were collected from Nsukka town (N06°.86. 43.5 and E07°.42.56.0) in Nsukka, Nsukka Local Government Area Enugu State, Nigeria.

The *Dracaena* species (Figure 1) were authenticated at Bio-diversity Development and conservation, Nsukka, where the voucher specimens were deposited.

Phytochemical procedure

Seven phytochemicals were examined. They included cyanide, phytate, lectin, alkaloids, flavonoids, saponins and calcium oxalate crystals.

Preparation of plant materials for phytochemicals analysis

Fresh leaves, stems and roots of *D. mannii* and *D. arborea* were washed and blended with an electric blender. 250 g of each of the ground samples were soaked in 200 ml of water for 24 h. They

were then filtered with cheese cloth. The extract (50% yields) were concentrated by means of rotary evaporator, and subjected to tests.

Qualitative test was conducted first to determine the presence or absence of these phytochemicals. This was done using standard procedure as describe by Harborne (1973).

Quantitative phytochemicals analysis

Similarly, quantitative test was carried out using standard procedures.

Determination of cyanide

1 ml of each of the sample extract was transferred into different test tubes; 4 ml alkaline picrate was added into each and allowed to stand for 5 min. Blank containing distilled water, and a standard were prepared and the absorbance read at 490 nM with spectrophotometer. This is in accordance with the method of Onwuka, (2005).

Determination of calcium oxalate

Following the method of Pearson (1978), 10 ml of each extract was transferred to100 ml flasks and 30 ml diethyl ether added into each flask. The pH of each filtrate was adjusted to 7.0 with NH_4OH. 0.1 M KMnO4 was titrated against each filtrate, noting the initial and final volumes of $KMnO_4$.

Determination of alkaloid

In accordance with the method of Harborne (1973), 20 ml of each of the extract was concentrated by heating over a water bath to one quarter of the original volume. NH_4OH solution was added drop wise until precipitation is completed and allowed to settle. The precipitates were collected and washed with dilute NH_4OH solution and then filtered. The residues were weighed and reported as the crude alkaloid.

Determination of saponin

According to the method outlined by Obadoni and Ochuko (2001), 10ml of each extract was transferred in 250 ml separator funnels and washed with 20 ml diethyl ether. Two layers were separated in each- the aqueous layer and the ether layer. The aqueous layers were recovered and the ether layers discarded. The purification process was repeated. 60 ml of n-butanol was added into the extracts and the extracts washed twice with 10ml of 5% aqueous NaCl. The remaining solutions were heated over a water bath. After evaporation, the samples were dried in already weighed beakers in an oven to constant weights. The final weights were obtained and the saponin calculated in percentages.

Determination of flavonoid

Following the procedure of Boham and Kocipa (1974), 100 ml 0f each extract was filtered using Whatman filter papers number A_1, B_1, C_1, A_2, B_2, C_2 and the filtrates were transferred into weighed crucibles and evaporated to dryness over a water bath. Each crucible was re-weighed and percentage flavonoid calculated.

Determination of lectin

In accordance with the method of Harborne (1973), to 1 ml of each extract diluents in a test tube, 1 ml of heparinized rabbit blood was added. A blank of red blood cells and normal saline was prepared and the extracts in the test tubes were allowed to stand for 4 h at room temperature. 1 ml of normal saline was added to all the tubes and allowed to stand for 10 min after which the absorbance was read at 620 nM using a spectrophotometer. The test tube containing only the blood cells and normal saline served as the blank. The lectin units were determined using the equation: Letin unit/mg= (b-a) x F; where b = absorbance of test sample solution; a= absorbance of blank; F= experimental factor given by F= (1/w x vf/va) D where w= weight of sample; vf= total volume of extract; va= volume of extract used in the assay; and D= dilution factor (if any).

Determination of phytate

Using the procedure according to the Oberlease (1973), 0.5 ml of the extracts each was pipetted into 4 test tubes fitted with ground glass stoppers. 1 ml of 0.2 g NH_4+Fe (111) sulphate. $12H_2O$ in 100 ml and 2 N HCl made up to 100 ml were added to each and fixed with clips. The tubes were heated in a boiling water bath for 30min. taking care that the tube remained well stoppered the first 5 min. They were cooled in ice water for 15 min and allowed to adjust to room temperature. The content of each tube was mixed and centrifuged for 30 min at 3000 r.p.m. 1 ml of each supernatant was transferred to 4 test tubes and 1.5 ml of solution 3 (10 g of 2,2-dipyridine + 10 ml thioglycollic acid in distilled water made up to 100ml) was added. The absorbance was read at 519 nM using spectrophotometer against the blank.

Statistical procedure

The results were analyzed using t-test and results were presented in mean±SD.

RESULTS

Table 1 shows the presence or absence of the seven phytochemicals in the parts tested.

Flavonoid, cyanide and saponin were present in all the parts tested in both plants. Calcium oxalate was lacking in the leaf and root of *D. mannii* and root of *D. arborea*. Alkaloid was lacking in the stem and root of *D. mannii* and in root of *D. arborea* while phytate was absent from the roots of both *Dracaenas* species. Lectin was absent from the leaves of *D. arborea* and from stem and root of *D. mannii.*

Table 2 shows varying quantities of the seven phytochemicals in the leaves, stems and roots of the two *Dracaena* species with some parts lacking the phytochemicals. *D. arborea* leaves contained the highest percentage of calcium oxalate crystals while *D. mannii* leaf contained the highest percentage of lectin, flavonoid and phytate. The root of *D. arborea* lacked calcium oxalate, alkaloid and phytate while the root of *D. mannii* lacked calcium oxalate, alkaloid, phytate as well as lectin. The leaf of *D. mannii* lacked calcium oxalate while that of *D. arborea* lacked lectin. Both *D. mannii* and *D. arborea* were low in cyanide content in all the parts tested. The

Table 1. Qualitative phytochemical content of the leaf, stem and roots *of D. arborea* and *D. mannii*

Phytochemicals	*D. arborea*			*D. mannii*		
	Leaf	**Stem**	**Root**	**Stem**	**Leaf**	**Root**
Calcium oxalate	+	+	-	+	-	-
Flavonoid	+	+	+	+	+	+
Saponin	+	+	+	+	+	+
Alkaloid	+	+	-	-	+	-
Lectin	-	+	+	-	+	-
Phytate	+	+	-	+	+	+
Cyanide	+	+	+	+	+	+

+, = presence; =, absence.

Table 2. Quantitative phytochemical content of the leaf, stem and roots of *D. arborea* and *D. mannii.*

Phytochemicals	*D. arborea*			*D. mannii*		
	Leaf	**Stem**	**Root**	**Leaf**	**Stem**	**Root**
Calcium oxalate	6.25±0.01	2.44+0.34	0.00 -0.00	0.00+ 0.00	2.50- 0.53	0.00 +0.04
Flavonoid	3.87±0.20	4.14±0.82	2.20±0.25	4.50± 0.32	2.00±0.25	1.10±0.15
Saponin	1.18±0.10	0.48±0.13	0.15±0.14	1.00± 0.31	1.00±0.32	0.50 ±0.37
Alkaloid	0.53±0.10	2.08±0.54	0.00±0.00	0.50±0.42	0.00±0.00	0.00 ±0.00
Lectin	0.00±0.00	10.02±0.20	0.18±0.26	170.00±0.25	0.00±0.00	0.00 ±0.00
Phytate	17.95±0.30	11.30±0.50	0.00±0.00	90.00±0.14	22.20±0.19	0.00±0.00
Cyanide	0.12±0.10	0.10±0.10	1.20±0.15	0.16 ± 0.66	0.10±0.25	1.50 ±0.27

same percentage of saponin was found in the leaf and stem of *D. mannii* and in the leaf of *D. arborea* while the leaf of *D. arborea* and the stem of *D. mannii* contained the same percentage of cyanide.

DISCUSSION

The results of the study showed varying quantities of the seven phytochemicals in the leaves, stems and roots of the two *Dracaena* species with some parts lacking some of the phytochemicals (Table 1*). D. arborea* leaf contained the highest percentage of calcium oxalate crystals (6.25± 0.01) while *D. mannii* leaf contained the highest percentage of lectin (170 0.25), flavonoid (4.50 0.32) and phytate (90 0.14), respectively (Table 1). The root of *D. arborea* lacked calcium oxalate, alkaloid, and phytate while the root of *D. mannii* lacked calcium oxalate, alkaloid, phytate as well as lectin. Both species were low in cyanide content in all the parts tested. The same percentage of saponin was found in the leaf and stem of *D. mannii* and in the leaf of *D*. *arborea* while the leaf of *D. arborea* and the stem of *D. mannii* contained the same percentage of cyanide.

None of the two species lacked entirely all the seven phyt ochemicals in all the parts tested this is in agreement with the result of Watson and Dallwitz (1992) in which they stated that *Dracaena*s are non cyanogenic and lack alkaloids. However, the leaves, stems and roots of both species tested positive for flavonoid and saponin which is in consonance with their report that *Dracaenas* contain flavonoid and saponin. Also, Pennisi and McConnel (2004) reported the presence of cuticular deposits of calcium oxalate crystals in 14 species of *Dracaena* they studied. This was also reported in this research in the leaf and stem of *D. arborea* and in the stem of *D. mannii*. These phytochemicals are known to have medicinal properties.

Flavonoids are phytochemical compounds which are widely distributed in all the vascular plants, (Harborne, 1973). They have antioxidant activity; some of the activity attributed to flavonoid includes anti-allergic, anti-cancer, anti-oxidant, anti-inflammatory and anti-viral. Flavonoid functions in defense against herbivores, management of diseases such as malaria, diabetes and hypertension, (Judd et al., 1999; Thompson, 1994).

Alkaloids are structurally diverse and are derived from different amino acids or mevalonic acids by various biosynthetic pathways (Robinson, 1981). They have an intensively bitter taste and many are extremely poisonous (Dutta, 2004). The amazing effect of these alkaloids on human has led to the development of pain-killer medication,

spiritual drugs and serious additions by those who are ignorant of the properties of the powerful chemical (Harborne et al., 1973). They are physiologically active in animals, usually even at very low concentrations, and many are widely used in medicine (for example cocaine, morphine, atropine, colchicines, quinine, and strychnine).

Saponins are glycosides with distinctive foaming characteristics (Judd et al., 1999). They are natural detergents found in many plants (Ajali, 2004). Saponins have both antibacterial and antifungal properties and are used extensively in cosmetics, such as lipsticks and shampoo.

Calcium oxalate is a phytochemical compound that forms niddle-shaped crystals. It is found in large quantity in the poisonous plant, dumb cane (*dieffenbachia*). It is also found in various species of Oxalis, Araceae and Agavaceae (Fabricant and Farnsworth, 2001). According to them, calcium oxalate is poisonous when ingested and even a small dose of it is enough to cause intense sensations of burning in the mouth and throat, swelling, and choking. In large doses, it causes severe digestive upset, breathing difficulties and if enough is consumed, convulsion, coma and death. Recovery from severe calcium oxalate poisoning is possible, but permanent liver and kidney damage may have occurred.

Phytate also known as phytic acid or inosytol hexaphosphate (IP6) is the storage form of phosphorus in many plant tissues. Phosphorus in this form is generally not bio-available to humans because it lacks the digestive enzyme, phytase required to separate phosphorus from the phytate molecule (Fabricant and Farnsworth, 2001). Recent studies have indicated that phytic acid may have some preventive effect in prostrate, breast, pancreatic and colon cancer (Fabricant and Farnsworth, 2001).

Lectins are glycoproteins of 60,000-000 MW that are known for their ability to agglutinate erythrocytes in vitro and are of therapeutic use against HIV-1 (Robinson, 1981). Jacalin, a plant lectin has been found to completely block human immuno deficiency virus type 1 in vitro infection of lymphoid cells. This activity of jacalin is attributed to its ability to specifically induce the proliferation of $CD4^+$ T lymphocytes in human. Lectins could also be potential use in cancer treatment strategies due to the fact that lectin present on the surface of tumour cell are capable of binding exogenous carbohydrate-containing molecules and internalize them by endocytosis (Robinson, 1981).

Cyanogenic glycosides are poisonous and have been implicated for the death of some domestic animals for example the ornamental *Euchalyptus* (Dubrovsky, 2005). Cyanogenic glycosides in plants yield free hydrocyanic acid otherwise known as prussic acid glycosides, when hydrolyzed by ß-glycosides or when other plant cell structure is disrupted or damaged, for example by freezing, chopping, or chewing. Microbial action in the rumen can further release free cyanide (Greenwood, 1989). Ruminants are more susceptible than monogastric animals, and cattle slightly more so than sheep (Dubrovsky, 2005).

Conclusion

The result shows that there is no significant difference in the phytochemistry of *D. mannii* and *D. arborea.* In other words, the two species are closely related and this justifies their placement in the same genus *Dracaena*. The slight differences existing between them also justify their separation into different species. Also, that, the two species could be used in ethnomedicine for the treatment of diseases such as malaria, diabetes, bacterial and fungal infections and even cancer.

Conflict of interest

The authors have declared that there is no conflict of interest.

Authors' contributions

This work was carried out in collaboration of all authors. Authors RUU and CVI designed the study, carried out the experiment and wrote the first draft of the manuscript. All authors managed the analyses of the study. Author CUO supervised the work. All authors read and approved the final manuscript.

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