

Pentadiplandra brazzeana Baill. (Pentadiplandraceae): Chemical screening assessment and a mini-review on its Bioactivity and Phytochemistry

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ABSTRACT:

In Africa, about 80% of population relies on traditional medicine for their health care purpose. The aim of the present study was to evaluate the chemical composition of the plant species *Pentadiplandra brazzeana* Baill. used as dietary and medicinal plant by indigenous people in the Province of Nord-Ubangi and to provide update knowledge on phytochemistry and bioactivity of this plant species. A literature search was conducted to obtain information about the phytochemistry and pharmacognosy of *Pentadiplandra brazzeana* from various electronic databases (PubMed, PubMed Central, Science Direct and Google scholar). The scientific name of this plant species was used as a keyword for the search, along with the terms phytochemistry and pharmacognosy. The chemical structures of the *P. brazzeana* naturally occurring compounds were obtained from PCIDB (PhytoChemical Interactions DB) or drawn using ChemBioDraw Ultra 12.0 software package. Phytochemical screening revealed the presence of alkaloids, linked quinones, saponins, tannins and triterpenoids in both the leaves and roots. While anthocyanins, flavonoids and leuco-anthocyanins are present in the leaves but absent in the roots. Findings revealed that this plant is traditionally used in African folk medicine to treat various ailments including intestinal parasitic diseases and against Chlamydiae. The roots are used for food flour preservation. These roots smelling a raifort pungent odor are edible because of their sweet taste. The ethnopharmacological relevance of this plant species is due to the presence of sulfur-containing phytochemicals. The present study can, therefore, help inform future scientific research towards the development of novel drugs of relevance from *P. brazzeana* for the improvement of human health and wellbeing.

Keyword: *Ethno-medicine, medicinal plants, Pentadiplandra brazzeana, sulfur-containing phytochemicals, Democratic Republic of the Congo.*

INTRODUCTION

The Democratic Republic of the Congo forest is a large terrestrial biome which plays the role of biodiversity reservoir. This forest covers approximately 62% of the national territory [1]. Among biological resources of this forest, medicinal plants are the key product for the Congolese population. Almost all Congolese populations, both urban and rural, depend on medicinal plants for their health care needs because the costs of conventional drugs are often unaffordable. These plants have found to have therapeutic value for solving major health problems [2-12].

In order to preserve the ethno-medical cultural heritage of the Nord-Ubangi province in Democratic Republic of the Congo, the present study was undertaken with the aim of evaluating both the chemical composition of *Pentadiplandra brazzeana* and to provide update mini-review on its biologically active metabolites/compounds and bioactivity. *P. brazzeana* (Pentadiplandraceae) is used in African folk medicine to treat intestinal parasitic diseases and against Chlamydiae. The roots are used for food flour preservation are also edible because of their sweet taste [13].

MATERIALS AND METHODS

Plant material collection and identification

The tested plant materials used in this study were collected in Democratic Republic of the Congo during a field work in March 2013 and were authenticated by Mr B.L. Nlandu of the INERA (Institut National d'Etudes et Recherches Agronomiques). Vouchers specimens are on deposit at the INERA Herbarium of the Faculty of Science (University of Kinshasa).

Extraction and chemical screening

The dried and powdered plant material (10 g) was repeatedly extracted by cold percolation with 95% ethanol and water (100 mL x 2) for 48 hours. Chemical screening was done according to a well-known protocol as previously reported [5-8, 14, 15].

o Detection of flavonoids

The ethanol extract (5 ml) was added to a concentrated sulphuric acid (1 ml) and 0.5g of Mg. A pink or red coloration that disappear on standing (3 min) indicates the presence of flavonoids.

o Detection of anthocyanosids

The presence of anthocyanosids is revealed by a color change as a function of pH due to titration of the acidic aqueous solution with a solution of NaOH. If the solution turns a red color, the pH is less than 3, if against a blue color; the pH is between 4 and 6.

o Detection of tannins

Two methods were used to test for tannins. First, about 1 ml of the ethanol extract was added in 2 ml of water in a test tube. 2 to 3 drops of diluted ferric chloride solution was added and observed for green to blue-green (catechic tannins) or a blue-black (gallic tannins) coloration. Second, 2 ml of the aqueous extract was added to 2 ml of water, a 1 to 2 drops of diluted ferric chloride solution was added. A dark green or blue green coloration indicates the presence of tannins.

o Detection of leucoanthocyanins

To 2 ml of aqueous extract was added few drop of Shinoda reagent in a test tube and then boiled. A red or purple coloration in the supernatant indicates the presence of leucoanthocyanins.

o Detection of saponins

To 1 ml of aqueous extract was added few volume of distilled water in a test tube. The solution was shaken vigorously and observed for a stable persistent froth for 20 min.

○ **Detection of alkaloids**

Five ml of the extract was added to 2 ml of HCl. To this acidic medium, 1 ml of Dragendroff's reagent was added. An orange or red precipitate produced immediately indicates the presence of alkaloids.

○ **Detection of free quinones**

To 1 ml of organic extract was added few drops of Borntrager reagent (NaOH 10% ou NH₄OH 10%) in a test tube. The solution was and then shaken vigorously. A sharp red or orange coloration indicates the presence of free quinones.

○ **Detection of triterpenoids**

Ten (10) mg of the extract was dissolved in 1 ml of chloroform; 1 ml of acetic anhydride was added following the addition of 2 ml of Conc.H₂SO₄. Formation of reddish violet colour indicates the presence of triterpenoids.

Literature search

A deep literature search was carried out in order to obtain information about the phytochemistry and bioactivities of *Pentadiplandra brazzeana* from various electronic databases namely PubMed, PubMed Central, Science Direct and Google scholar.

The scientific name of this plant species was used as the keyword for the search, along with the terms phytochemistry, bioactivities, pharmacology and pharmacognosy. The chemical structures of the *Pentadiplandra brazzeana* naturally occurring compounds were obtained from PCIDB (PhytoChemical Interactions DB) or drawn using ChemBioDraw Ultra 12.0 software package.

RESULTS AND DISCUSSION

○ **Chemical screening**

The chemical screening of *Pentadiplandra brazzeana* revealed the presence of Alkaloids, linked quinones, saponins, tannins and triterpenoids in both the leaves and roots. While anthocyanins, flavonoids and leuco-anthocyanins are present in the leaves but absent in the roots. Free quinones were absent in the two organs. The richness of *Pentadiplandra brazzeana* in secondary metabolites could justify the wide use of this plant species by traditional healers.

○ **Literature search results**

The online search showed that the chemical compounds found in this plant have various biological properties. Among them, glucosinolates (GLs) (present in root, seed, and leaf) form a variety of hydrolysis derived-products including isothiocyanates (ITCs), oxazolidine-2-thiones, nitriles, epithionitriles, and thiocyanates [16]. Isothiocyanates are well known for their bioactivities including bactericidal, nematocidal, fungicidal, insecticidal, antioxidant, antimutagenic, antiproliferative and allelopathic properties [17].

The root of *P. brazzeana* contains arylalkyl isothiocyanates and related thiocarbamates and thioureas. The isolated arylalkyl ITCs were benzyl ITC, 4-methoxybenzyl ITC, and 2-(4-methoxyphenyl)-2,2-dimethylethyl ITC, which would indicate the presence of benzyl-, 4-methoxybenzyl-, and 2-(4-methoxyphenyl)-2,2-dimethylethyl GL, respectively, in the root of *P. brazzeana*. Choline is also present in *P. brazzeana*.

P. brazzeana (figure 1) is a climber widely distributed Africa and its berries are eaten and used as a sweetener of beverages [18]. Root, seed, and leaf extracts of *P. brazzeana* contain benzyl-, 3-methoxybenzyl-, 4-methoxybenzyl-, 3,4-dimethoxybenzyl-, and indole-type glucosinolates [19] and the essential oil obtained from its roots is mainly constituted of benzylisothiocyanate and benzylcyanide [20-22].

Its root derived essential oil was reported to possess free-radical scavenging [21, 23], antibacterial [23], antifungal [22, 23], and anti-inflammatory activities [23]. The aqueous extract of root possesses androgenic activity [24]. Thiourea and urea isolated from the root of *P. brazzeana* exhibited moderate antiplasmodial activity [17].

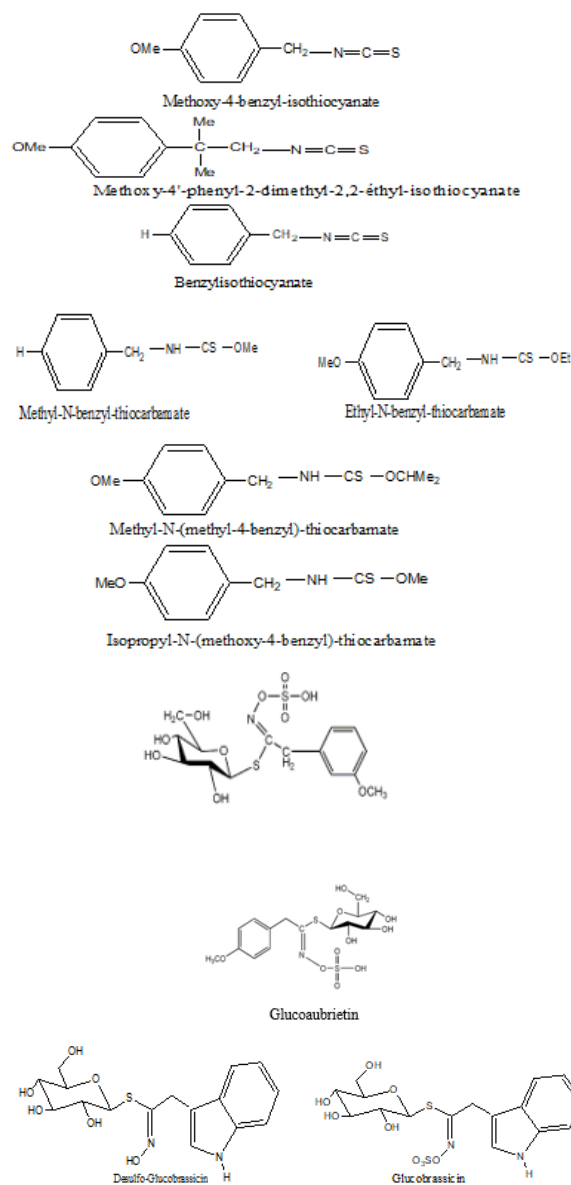
A thermostable sweet-tasting protein namely brazzein (54 amino acid residues and four disulfide bonds: 6,473 Da) was isolated from the fruit of *P. brazzeana*. This protein is 2,000 times sweeter than sucrose in comparison to 2% sucrose aqueous



solution and 500 times in comparison to 10% of the sugar. Its taste is more similar to sucrose [25].

Figure 1: Leaves, fruits (1a) and roots (1b) of *Pentadiplandra brazzeana* [26]

The figure 2 gives the chemical structure of some bioactive compounds isolated from *P. brazzeana*.



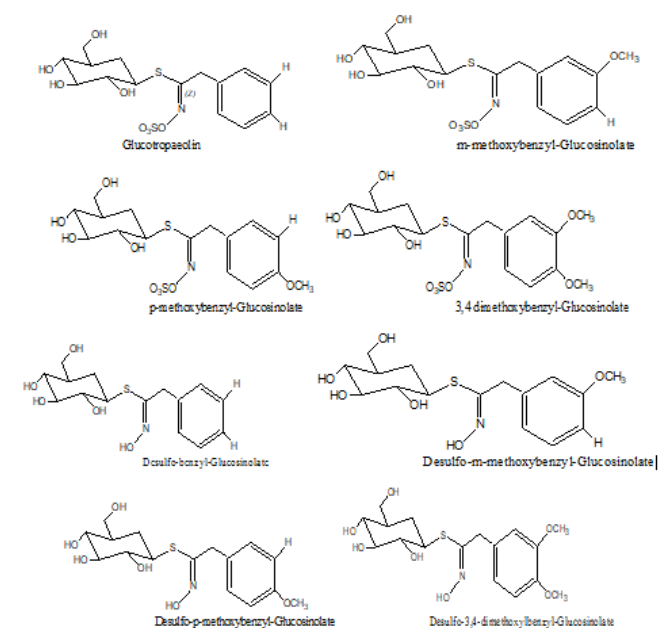


Figure 2: Some biologically active compounds isolated from *P. brazzeana* [27].

Table 1: Traditional uses of the plant *Pentadiplandra brazzeana*

Plant part	Indications [28]
Root bark (mixed with fruit of <i>Piper guineensis</i>)	<ul style="list-style-type: none"> - Kidney pains - Haemorrhoids - Aphrodisiac - Antibleorrhagic - Antalgic - Antitussive - Antisyphilitic - Cough - Malaria - Gonorrhoea, etc.
Root bark bark	<ul style="list-style-type: none"> - Aphrodisiac - Stimulate lactation - Tooth pains - Rheumatism - Haemorrhoids - Intercostal and - Abdominal pains - Malaria, etc.
Leaf (mixed leaf of <i>Morinda morindoides</i>)	<ul style="list-style-type: none"> - Febrifuge - Malaria, etc.
Leaf	<ul style="list-style-type: none"> - Scabies
Tuber	<ul style="list-style-type: none"> - Gonorrhoea - Dysentery - Anthelmintic - Antimalarial, etc.

Table 1: Traditional uses of the plant *Pentadiplandra brazzeana*

Part of plant	Compounds	Bioactivity	Model system	Ref.
Root	1, 3-bis (4-methoxybenzyl) urea	activity toward recombinant human and recombinant	Rat sEH	[29]
	Flavonoids	Antiamoebic activity	<i>Entamoeba histolytica</i>	[28]
	Tanins	Spasmolytic activity	Guinea-pig ileum	[28]
	Flavonoids	Antibacterial activity	<i>Bacillus subtilis</i> , <i>Escherichia coli</i> , <i>Salmonella enteritidis</i> , <i>Shigella dysenteria</i> , <i>Staphylococcus aureus</i> <i>Shigella flexneri</i> <i>Salmonella thymurium</i>	[28]
	Alkaloids	Androgenic activity	Male rats	[24]

Medicinal plants like *Pentadiplandra brazzeana* Baill. represent a rich source of biologically active secondary metabolites like sulfur-containing natural products glucosinolates and its derivatives (Isothiocyanates, thiocarbamates, oxazolidine-2-thiones, nitriles, epithionitriles etc.). The bioactivity of this medicinal plant species was confirmed using various model systems like small mammals, protozoan and bacteria.

CONCLUSION

The present study revealed the presence of alkaloids, linked quinones, saponins, tannins and triterpenoids in both the leaves and roots of *Pentadiplandra brazzeana*. While anthocyanis, flavonoids and leuco-anthocyanins are present in the leaves but absent in the roots. Findings revealed that this plant is traditionally used in African folk medicine to treat various ailments including intestinal parasitic diseases and against Chlamydiae. The roots are used for food flour preservation. The

roots are edible. The ethnopharmacological relevance of this plant species is due to the presence of sulfur-containing phytochemicals. Thus these results can, therefore, help inform future scientific research towards the development of novel drugs of relevance from *P. brazzeana* for the improvement of human health and wellbeing.

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