Bioactive compounds from eight plant species traditionally used in Madagascar as medicines: A mini-review

Koto-te-Nyiwa Ngbolua,1,2* Ruphin Pierre Fatiany,3,4 Robijaona Baholy,3,5 Gloria Kabuo Sifa,1 Jules M. Tshishimbi,1 Virima Mudogo,1 Pius T. Mpiana1

ABSTRACT

The aim of this mini-review was to give an overview on our recent findings on some plant species ethno-medically used in the south of Madagascar. Based on ethno-pharmacological approach, we used the consistent in vitro model systems and modern phytochemical techniques for the scientific validation of the bioactivity of selected medicinal plants and their molecules. In this work, we reported 45 compounds identified from the essential oils of four aromatic plants (Croton greveanus, C. borarium, C. geayi and Hazomalania voyronii). This oil displayed bactericidal. Eight biologically active molecules were isolated and characterized from four medicinal plants (Salacia leptoclada, Diospyros querina, Eliea articulate and Cymbopogon pruinuous) justifying their use in traditional medicine. These results show that the Malagasy plant species can serve as source of antibacterial, antiplasmodial, cytotoxic and vasodilator hits.

Key words: Ethno-pharmacology, medicinal and aromatic plants, bioactive compounds, infectious diseases, hypertension

1. INTRODUCTION

The island of Madagascar, located in the Indian Ocean, presents all the characters of a small continent. Its flora is of an interest because of its diversity and its very great richness. The current Malagasy flora is marked by the persistence of kinds and very antiquated species belonging to only known families with the state of fossils on the other continents. Madagascar constitutes one of the most important biodiversity hotspots worldwide with more than 90% of its plant species being endemic. This rate of endemism is besides raised on all the taxonomic levels, eight families are regarded as being entirely endemic of the island.1-5 Medicinal plants are a validated source for the discovery of new leads and standardized herbal medicines. The aim of this research program was to validate scientifically the ethno-medical use of eight plant species of Madagascar for their pharmaceutical application against tropical infectious pathologies (like malaria and bacterial diseases) and hypertension.

2. MATERIALS AND METHODS

Ethno-botanical surveys were conducted in the South of Madagascar (according to the convention on the biological diversity) and plant species were selected based on informant consensus factor among traditional healers.6 The bioassay-guided fractionation of plant extracts was carried out by the combination of chromatography techniques (TLC and column chromatography) and in vitro bioassay using P. falciparum and P388 leukemia cell lines as models.1,2 The structure of the biologically active pure compound was elucidated by 1D and 2D NMR spectroscopy and Mass spectrometry.1,2,7,8 Essential oil (EO) extractions were done by hydro-distillation using a Clevenger-type apparatus while; their quantification and analysis were done by GC-FID and GC/MS.9,9 The antimicrobial activity of the oil was assessed by both diffusion disc and micro-dilution tests.10-14 Bacillus subtilis ATCC 6633, Staphylococcus aureus ATCC 25923, Bacillus cereus ATCC 10876, Escherichia coli ATCC 25922, Salmonella typhi ATCC 13311, Pseudomonas aeruginosa ATCC 27853 and Enterobacter cloacae ATCC 13047, etc. as model systems for validating the bioactivity of EO. The density functional theory and 2D NMR spectroscopy and Mass spectrometry.1,2,7,8 Essential oil (EO) extractions were done by hydro-distillation using a Clevenger-type apparatus while; their quantification and analysis were done by GC-FID and GC/MS.9,9 The antimicrobial activity of the oil was assessed by both diffusion disc and micro-dilution tests.10-14 Bacillus subtilis ATCC 6633, Staphylococcus aureus ATCC 25923, Bacillus cereus ATCC 10876, Escherichia coli ATCC 25922, Salmonella typhi ATCC 13311, Pseudomonas aeruginosa ATCC 27853 and Enterobacter cloacae ATCC 13047, etc. as model systems for validating the bioactivity of EO. The density functional theory studies were used for predicting the cytotoxicity of the isolated compound.

3. RESULTS AND DISCUSSION

3.1. Antibacterial activity

45 compounds were identified from the essential oils of four aromatic plants which displayed bactericidal activity:
Bioactive compounds from eight ... Koto-te-Nyiwa Ngbolua, et al.

• Hazomalania voyronii
  (-) Spathunelol (42.3%), Eucalyptol (22.0%), Limonene (10.3%), Borneol (10.2%), Myrtenal (2.0%), Perrylaldehyde (1.3%) and α-pinene (1.4%). The essential oil from H. voyronii displayed also vasorelaxant activity. 3

• Croton greveanus
  1.8 cineol (40.40%), linalol (23.81%) and α-terpineol (8.2%), sabinen transhydrate (10.17%), sabinen (6.87%) and finally terpinen-4-ol (1.52%).

• Croton borarium
  β-phellandren (39.72%), α-terpineol (25.121%), and camphene (13.74%), α-pinene (10.70%). The minor compounds were terpinen-4-ol (1.71%), germacren-D (6.68%), α-copaen (4.71%), sabinen (3.63%), β-pinene (2.46%), limonene (2.31%), β-caryophylen (2.18%), α-hulemen (1.76%), p-cymen (1.051), γ-terpinen (1.29%), β-myrcen (1.22%) and epoxy-caryophyllen (1.092).

• Croton geayi
  β-pinene (28.74%), limonene (22.92%) and secondarily by eucalyptol (10.42%), α-terpineol (8.2%), transhydrate of sabinen (5.67%), β-Phellandren (7.47%), β-caryophylen (4.80%), α-pinene (4.32%), trans-norloliden (3.88%), β-myrcen (3.06%), germacren-D (2.56%), cis-norloliden (2.50), aromadren (2.35%), fenchol (2.04%), sabinen and terpinen-4-ol (1.05%), caryophyllen oxide (1.09%).

3.2. Antiplasmodial and cytotoxic activities
An antiplasmodial compound belonging to the chemical family of quinones methides was isolated from Salacia leptoclada with a therapeutic index of 0.788. Three cytotoxic compounds [Isodiospyrin, 6′ethoxy-1′,3′,5′-trihydroxy-4,6-dimethyl-1,2′-binaphthyl-2′,5′,8′,8′-tetraone, (E)-5,6-dimethyl-2-(2-methyl-3-(prop-1-enyl)phenyl)-2H-chromene] were also isolated from the root bark of Diospyros quercina.

The density functional theory studies on molecular structure and reactivity of quinone methide pentacyclic triterpenoid derivative isolated from Salacia leptoclada confirmed the cytotoxicity of this compound through it interaction with adenine (as revealed by the energy value of optimized geometry of complex with adenine in orientation D, figure 3). This result indicates that DNA (Deoxyribonucleic acid) could be a putative target of such bioactive compound which could be act as DNA replication inhibitor (inhibition mammal cells or cancerous cells division).
Conclusi3.3. Vasorelaxant activity

The arial part of Cymbopogon pruinosus is widely used in the Southern part of Madagascar for the treatment of hypertension. Bioassay-guided fractionation of this plant led to the isolation and structural characterization of two bioactive pure compounds: Scopoletin and Bis(2-ethyl hexyl) phthalate (DEHP). The vasorelaxant effect of Cymbopogon pruinosus extract and it bioactive compounds were found to be partially endothelium dependent, mediated by nitric oxide.

The role of plant species as sources of the pharmacologically active compounds is well documented. They constitute a pivotal pipeline for pharmaceutical discovery. These phytochemical constituents are protective, disease preventing plant substances. Over the time, the animal kingdom developed anti-parasitic behaviors through plant-animal co-evolutionary interactions in which some animal phylum like human primates utilize the chemical defenses of plants to protect themselves from their own parasites or to solve health problem.

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