INSECTICIDE POTENTIAL OF FERN AND LICOPHYTES ESSENTIAL OILS

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Introduction

Insects are arthropods with public health importance since many species act as disease vectors [1]. Synthetic insecticides constitute the base of combat program and insect disease vector control, but the indiscriminate use of these substances cause selection of resistant insect population, in addition to being harmful to human health and environment [2]. Metabolites produced by several plant species have been studied, demonstrating repellent and/or insecticide potential. Among these metabolites, there are terpenes present in essential oils, which could represent a natural substitute to synthetic insecticides, reducing the harmful effects of these products [3]. The ferns and lycophytes (pteridophytes) are vascular plants without seeds with wide distribution worldwide, and several species possess a quite typical smell, due the presence of volatile constituents [4]. Many biological activities are assigned to this plant group, amongst them, antimicrobial, anti-inflammatory, antioxidant and insecticide [5]. Therefore, the present study aims to conduct a systematic survey involving essential oils from ferns and lycophytes, focusing on the rational search for active principles in plants.

Material and methods

The systematic survey was conducted in the SciFinder database. The genera of ferns and lycophytes, following PPG I (Pteridophyte Phylogeny Group) [6], were used as search terms. No temporal or language restrictions were specified. As inclusion criteria, only original articles that presented the chemical characterization of ferns and lycophytes essential oils, evaluating or not the biological activities, were selected. Review articles, monographs, master's or doctoral theses were excluded. The first screening was done by reading titles and abstracts. Selected articles were read in full and divided by plant groups. Data on the chemical composition of essential oils were tabulated in a Microsoft Excel spreadsheet. The chemical components were classified and their structures drawn. The tabulated data were later analyzed.

Results and discussion

A total of 76 works were found in the systematic survey and 51 remained after the application of exclusion criteria. The selected scientific articles were published between the years 1947 and 2020, 4 (7,9%) articles were related to the chemical characterization of essential oils from lycophytes, and 47 (92,1%) from ferns. According to the PPG I [6], there are three families of lycophytes and about 1,388 species, and 48 families of ferns and nearly 10,578 species. Of these, studies that evaluated the volatile constituents were found for 77 species belonging to 15 fern families and eight lycophyte species belonging to Selaginella family. The families with the highest proportion of

species studied were Equisetaceae (26.7%), Onocleaceae (20%) and Nephrolepidaceae (15.8%). The families with the lowest proportion of species studied were Thelypteridaceae (0.2%), Blechnaceae (0.4%), Athyriaceae, Dryopteridaceae and Polypodiaceae (all with 0.5%). The most studied fern genera were *Asplenium* L., *Dryopteris* Adans. and *Anemia* Sw., while the only lycophyte genus studied was *Selaginella* P.Beauv. Terpenes (mono- and sesquiterpenes) were the substances most commonly found in the essential oils of ferns and lycophytes. In addition to terpenes, polyketides, lipid derivatives, carotenoid derivatives and aromatic substances were frequently found in the essential oils of these plants. Terpenes comprise a wide variety of compounds of plant origin and present ecological importance as plant defensives against herbivores and pathogenic microorganisms. Some monoterpenes found in the essential oils of ferns and lycophytes were α-pinene, β-pinene, limonene, myrcene, α-terpinene and camphene. These substances have already been isolated and tested on different types of insects, causing mortality rates of up to 100% [7]. In addition, α-pinene and limonene monoterpenes have high repellent activity [8]. Among the sesquiterpenes found in essential oils are nerolidol and farnesol, substances that have larvicidal activity against *Aedes aegypti* (Linnaeus, 1762) - Diptera [9]. Other sesquiterpenes present were β-humulene, α- and β-muurolene, compounds associated with the protection of plants against herbivores [7].

Conclusion

The analysis of data described in the literature highlight the lack of studies involving the detection and characterization of essential oils components in ferns and lycophytes, as well as the evaluation of their insecticidal activity. However, it is believed that these plants have potential as insecticide, especially in relation to their volatile components.

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