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GENERAL REVIEW/REVUE GÉNÉRALE

The antifungal activity of Moroccan plants and the mechanism of action of secondary metabolites from plants

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Organic extract

Summary This review is based on a comprehensive literature search for existing knowledge about antifungal mechanisms of different secondary metabolites from plants. The secondary metabolites have been grouped into three major groups according to their biosynthetic origin. On another side, this review represents studies on antifungal activity of essential oils and extracts from Moroccan plants, against fungal species involved in human or plant diseases.

Introduction

Onychomycosis, or fungal onyxis are belonging to the fungal kingdom, reaching the nail unit of the hands or feet, they can beings dermatophytes, yeasts or molds. All nail diseases, onychomycosis represent half of cases [1] and an increasing prevalence of the latter is observed in the general population [2]. This common and cosmopolitan pathology, although it does not put life threatening, affects the quality of life and causes discomfort aesthetic and psychological. In addition, local pain and irritation may be associated, limiting walking or other physical practices [3].

The plant pathogenic fungi are a problem in the agricultural sector in Morocco. During storage, fruits and vegetables are often subject to varying levels of microbial decay, mainly due to pathogenic fungi, which usually infect the host through wounds sustained during harvest, handling and/or processing [4].

In the search for new antifungal drugs, many plants have been tested for their antifungal activity and mode of action. Many of the human fungal pathogens are developing resistance to already existing antifungal drugs, such as fluconazole and amphotericin B [5]. Therefore, there is an urgent need for new antifungal agents [6]. The secondary metabolites in plants are

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often a part of their own protective mechanism against phytopathogens [7].

This review, its main objective first of all, makes an inventory mechanisms of action of secondary metabolites and their antifungal activity and presents studies on antifungal activity of essential oils and plant extracts in Morocco, against fungal species involved in human or plant diseases.

Among natural resources, medicinal and aromatic plants play an important role in the economy in Morocco. The extracts of these plants have always been the subject of several studies views their role in biological activity.

Materials and methods

This review presents a set of studies on phytochemicals compound (secondary metabolites) of plant, and their mechanism of action on fungal cells, thus the review covers research on the morphology and composition of fungal cells, the literature search that ends with overview of Moroccan studies about antifungal activity. The period of the bibliographic search begins from July to November 2016.

The key words used in this research are: mechanism; antifungal activity; secondary metabolites; fungal cell; Essential oil; organic extract.

The databases searched are: PubMed and EMBASE.

Results and discussion

Phytochemical compound of plants

The secondary metabolites in plants can be divided into different categories according to their biosynthetic principles [8,9]. A simple classification includes 3 main groups (Fig. 1) [8].

Composition of the fungal cell

Fungal cells are eukaryotic and have a lot of similarities with mammalian cells, including DNA within the cell nucleus, mitochondria, endoplasmic reticulum and the Golgi apparatus. A point where mammalian and fungal cells differ is in the cell membrane. Both cells contain sterols in the cell membrane, but the content of sterols differs [5,10].

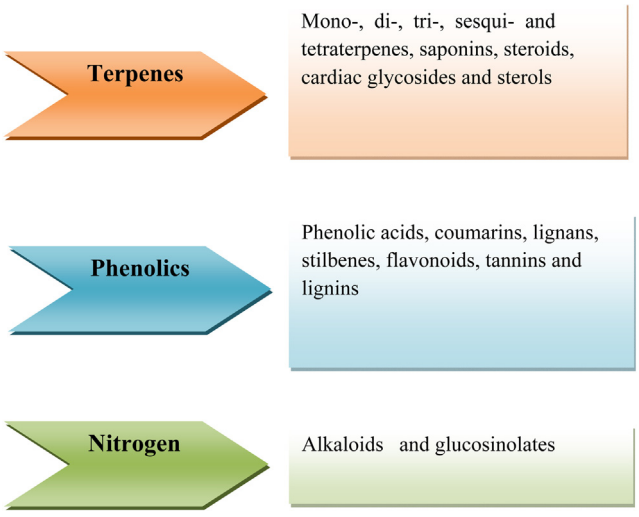

Figure 1 Phytochemical compound of plants.

Mammalian cells contain mainly cholesterol, while the fungal cells contain mainly ergosterol [5,10]. This difference in the sterol content has been a major drug target of interest in the search for antifungal agents [5,10]. The fungal cell wall is composed of different layers, mannoproteins being the external part of the cell wall (Fig. 2). The mannoproteins are supported by a matrix of β-glucan consisting of β-(1,3)-glucan and β-(1,6)-glucan and chitin mixed within the β-glucans [5]. The fungal plasma membrane consists of a phospholipid bilayer in which ergosterol is the main content [5,10].

Morphology of fungi

Most fungi are filamentous; they grow as individual rounded cells or dichotomous branched chains of cells with root like rhizoids for attachment for nutrient resource. The structures of fungi are composed of aggregated longs branching threads termed hyphae, with a diameter ranging from 1 to 30 μm or more, organized to support spores for reproduction and dissemination. The hyphae of these aerial structures extend and branch within the supporting substratum as network, termed a mycelium that displays considerable developmental plasticity, physiological and biochemical activities at different times, depending on local micro-environmental conditions. The colonies growing on homogeneous media may be pigmented, exhibit different morphological sectors, produce aerial structures, grow as fast-effuse or slow-dense forms and even exhibit rhythmic growth [5].

Ultra structure and function of fungal cells

The fungal cell encases the cytoplasm and comprises the plasma membrane, the periplasm, the cell wall and additional extracellular structural components.

The cell wall protects the fungal protoplast from the external environment and defines growth, cellular strength, shape and interactive properties.

The plasma membrane component of the fungal cell envelope is a phospholipid bilayer interspersed with globular

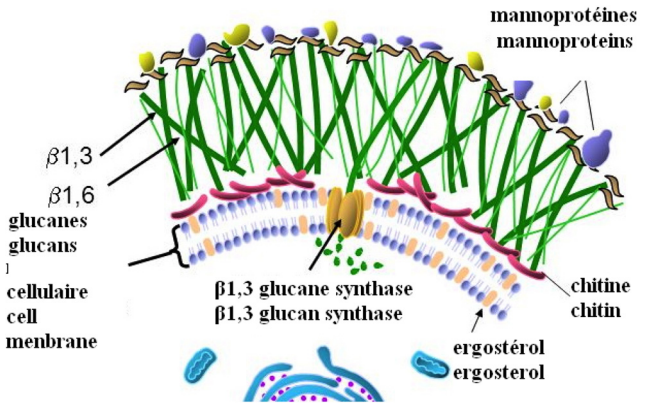

Figure 2 Composition of the fungal cell membrane and cell wall.

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