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Effects of Abiotic Stress on the Phytochemical Content and Bioactivity of Pistacia lentiscus L.

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Abstract : Introduction: Plant secondary metabolites (SM) can be grouped into three chemically distinct groups: terpenes, phenolics, and nitrogen-containing compounds. For many years the adaptive significance of SM was unknown. They were thought to be functionless end-products. Currently it is accepted that many secondary metabolites (also known as natural products) have important ecological roles in plants. For instance, they serve as attractants (odor, color, taste) for pollinators and seed-dispersing animals. Moreover, they protect plants from herbivores, microbial pathogens and from environmental stress (high and low temperatures, drought, alkalinity, salinity, radiation etc). It is well known that both biotic and abiotic stress often increase the accumulation of SM. The local climatic conditions, seasonal changes, external factors such as light, temperature, humidity affect the biosynthesis and composition of secondary metabolites. A well known dioecious evergreen plant, Pistacia lentiscus L. (mastic tree), was selected in order to study the metabolic variations occur in response to the different climate conditions, due to the seasonal variation and its effect on the biosynthesis of bioactive compounds. Materials-methods: Young and mature leaves were collected in January and July 2014, dried and extracted by accelerated solvent extraction (Dionex ASE™ 350) using solvents of increased polarity (DCM, MeOH, and H2O). GC-MS and UHPLC-HRMS analysis were carried out in order to define the nature and the relative abundance of SM. The antibacterial activity was evaluated by using the Agar Disc Diffusion Assay against ATCC and clinical isolates strains: Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans, Streptococcus mutans and Klebsiella pneumoniae. All tests were carried out in duplicate and the average radii of the inhibition zones were calculated for each extract. Results: According to the phytochemical profile obtained from each extract, the biosynthesis of SM varied both qualitatively and quantitatively under the two different types of seasonal stress. With exception of the biologically inactive nonpolar DCM extract of July, all extracts inhibited the growth of most of the investigated microorganisms. A clear positive correlation has been observed between the relative abundance of SM and the bioactivity of the DCM extracts of January and July. Observed changes during phytochemical analysis were mainly focused on the triterpenoid content. On the other hand, the bioactivity of the polar extracts (MeOH and H2O) of January and July resulted practically invariable against most of the microorganisms, besides the significant variation of the SM content due to the seasonal variation. Conclusion: Our results clearly confirmed the hypothesis of abiotic stress as an important regulating factor that significantly affects the biosynthesis of secondary metabolites and thus the presence of bioactive compounds. Acknowledgment: This work was supported by IKY - State Scholarship Foundation, Athens, Greece.
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