Volatile oil composition, antiproliferative and antimicrobial effects of the aerial parts of four aromatic herbs (fennel, dill, coriander, celery) growing in Jordan.

By: Al-Hasan Ali Al-salman
Supervisor: Prof. Dr. Fatma U. Afifi
Co-supervisor: Prof. Dr. Wamidh H. Talib

Abstract

Background: Pharmacological activities of phytochemicals have a huge impact on the pharmaceutical research and on the process of developing new drugs. Hence, numerous studies have been conducted to investigate the efficacy of plants, their fractions and isolated pure compounds for discovery of new therapeutic agents. Some medicinal plants are rich in volatile oils, representing an important source of anticancer and antibacterial drugs. It is worth to continue in investigation of aromatic, medicinal and edible plants.

Aim: The aim of the present study was to determine the volatile oil compositions of the fresh leaves as well as to evaluate the antiproliferative, and antimicrobial activities of the essential oils of four plants, grown in Jordan, (fennel, dill, coriander and celery) individually and in binary (50:50) and quaternary (25:25:25:25) mixtures.

Methods: The essential oil of the fresh leaves, obtained by hydrodistillation (HD) and the spontaneous emitted organic volatile compounds (VOCs) obtained by solid phase micro extraction method (SPME) were analyzed by gas chromatography (GC) and gas chromatography mass spectrometry (GC-MS) for their qualitative and quantitative comparison. *In-vitro* cytotoxic activities of the essential oil were evaluated against human epithelial breast (MCF-7) and human colorectal carcinoma (HCT-116) cell lines and compared to normal cell line (Vero) and positive control Doxorubicin by the MTT method. The half maximal inhibitory concentration (IC_{50}) for the essential oil of four plants were determined and the isobolographic method was then used to investigate the anticancer efficacy of the essential oil combinations by means of the combination index (CI). *In vitro* antimicrobial activities of the essential oils were evaluated against *Escherichia coli, Pseudomonas aeruginosa, Bacillus subtilis,* and *Candida albicans.* Minimal inhibitory concentrations (MICs) of the essential oils of four plants were determined and the checkerboard method was then used to investigate the antimicrobial efficacy of essential oil combinations by means of the fractional inhibitory concentration index (FICI).

Results: The results obtained for the volatile oil composition and on the aroma profile of four plants demonstrated the influence of the environmental factors on the qualitative and quantitative composition. Hence, as a result of this environmental variations, qualitative and quantitative differences in the composition of the oils were noticed in comparison with the data of other countries. The hydrodistilled oils of dill and celery were dominated by monoterpene hydrocarbons while the oils of fennel and coriander were rich in non-terpenoid substances. The aroma profile of dill, celery, and coriander was in agreement with the hydrodistilled oils, fennel aroma was rich in monoterpenes. Individually, essential oil of fennel exhibited best antiproliferative effect against MCF-7 and HCT-116 with IC_{50}'s 0.353mg/mL, and 0.424mg/mL, respectively. In binary mixtures, the best result was achieved with the combination of celery and fennel against MCF-7 cell lines with IC_{50} 0.215 mg/mL. In antimicrobial experiments, essential oil of dill yielded best activity active against *E.coli, P. aeruginosa, B. subtilis,* and *C. albicans*, with MIC's 10.0, 20.0, 5.0, and 5.0 mg/mL, respectively. Synergistic antimicrobial activity was observed with the fennel and dill oil combinations with coriander. Best results were detected with the binary combination of

coriander and dill against *P. aeruginosa*, and *B. subtilis* with MIC's 1.25 mg/mL for each of them. **Conclusions:** The data obtained from this study are the first demonstration of the volatile oil composition, antiproliferative, and antimicrobial activities of four plants individually and in combination grown in Jordan and may be used as a starting point for further research with these widely cultivated and naturalized species in Jordan.