

Determination of aroma profile, composition, and antimicrobial propensities of the essential oils of some common spices, alone and in combination.

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Abstract

Background: The interest in plants for the medical use has been increased in recent decades. Secondary metabolites present in plants are responsible for this interest due to their many biological activities such as antimicrobial activities. Spices are considered as one of the most common sources of bioactive compounds (such as essential oils) and used also in pharmaceutical products as antimicrobial agents.

Aim: The aim of the present study was to determine the volatile oil compositions of sweet basil and parsley fresh leaves, and dry seeds of cumin and dill as well as to evaluate the antimicrobial activity of the essential oils individually and in combination and to detect the occurrence of possible synergism in binary (50:50) and quaternary (25:25:25:25) mixtures of these spices.

Methods: The essential oils of the fresh leaves were obtained by hydro-distillation (HD) and the spontaneous emitted volatile organic compounds (VOCs) by solid phase micro extraction (SPME). The essential oils of the dry seeds were obtained by HD. The resulting essential oils and VOCs were analyzed by gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) for their qualitative and quantitative comparison.

The antimicrobial activities of the essential oils were evaluated *in vitro* against *Escherichia coli*, *Campylobacter jejuni*, *Staphylococcus aureus*, *Enterococcus faecalis*, and *Candida albicans*. Minimal inhibitory concentrations (MICs) of the essential oils of the four spices were determined and the fractional inhibitory concentration index (FICI) was calculated to evaluate the antimicrobial efficacy of the essential oil combinations. Minimal bactericidal and fungicidal concentrations (MBCs and MFCs) for the essential oils were also determined by plating mixtures onto agar plates.

Results: The results obtained for the aroma profile of the fresh samples and for the volatile oil of four spices revealed the influence of the environmental factors on the quantitative and qualitative composition. Hence, as a result of this environmental variation, differences in the quantitative and qualitative composition of the oils and in the emitted aroma volatiles was noted upon comparison with the results of other countries. Oxygenated monoterpenes accounted for compounds with the highest percentage in all samples with the exception of the hydro-distilled oils of parsley leaves, where hydrocarbon monoterpenes occurred in high percentages. Upon investigation the anti-microbial activity of four essential oils individually and in combination against *E. coli*, *C. jejuni*, *S. aureus*, *E. faecalis*, and *C. albicans*, better results were observed with the essential oil of cumin, which showed activity against all tested microorganisms with MICs 50, <0.78, 50, 25, and 50 mg/mL, respectively. The study also showed that *C. jejuni* was the most sensitive microorganism to all tested essential oils with MIC <0.78 mg/mL. The binary combination of all essential oils showed additive effects against *E. coli* and *C. albicans*. The binary (50:50) combination of fresh leaves of parsley and sweet basil showed additive effect against *E. coli*, *E. faecalis*, and *C. albicans*. **Conclusion:** The data obtained from this study is the first demonstration of the volatile oil composition and anti-microbial activity of the four spices individually and in combination in Jordan and may be used as a starting point for further research due to the wide use of these spices. It is also the first report for the VOCs composition of parsley and sweet basil leaves.

