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# ANTIFUNGAL ACTIVITY OF *SALVIA SCLAREA* ESSENTIAL OIL AGAINST *PENICILLIUM* SPP. STRAINS DETERMINED BY DISC DIFFUSION AND VAPOR CONTACT METHODS

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## Abstract

The search for natural agents to replace synthetic preservatives is currently one of the main trends in the food industry. From the possible natural alternatives to extend the shelf-life of products, application of essential oils (EOs) appears to be suitable for such purposes. The main objective of the present study was to evaluate the antifungal potential of *Salvia sclarea* (SC) essential oil (EO) - SCEO, in various concentrations (62.5; 125; 250; 500 µL x $L^{-1}$) against the growth of selected *Penicillium* spp. strains (*P. expansum*, *P. citrinum*, *P. crustosum*) inoculated on wheat bread (*in situ*).

The volatile substances of the SCEO were evaluated by a gas chromatograph coupled to a mass spectrometer (GC/MS), and its antioxidant properties were tested by free radical-scavenging capacity (DPPH assay). Disc diffusion method and vapor contact method were applied to determine the antifungal activity of SCEO in *in vitro* and *in situ* conditions, respectively. The obtained data was statistically evaluated using One-way analysis of variance (ANOVA) followed by Tukey's test.

GC/MS analysis revealed that 39 components were present in SCEO chemical composition. The major constituents were linalyl acetate (49.1%), linalyl (20.6%), and (E)-caryophyllene (5.1%). The antioxidant activity of the SCEO was weak with the value of inhibition 0.7 ± 0.3%, which corresponds to 56.0 ± 2.7 µg TEAC x $mL^{-1}$. From the results it is clearly evident that the in vitro antifungal efficacy of the *Salvia sclarea* EO against the analyzed *Penicillium* spp. depended on its concentration, and with increasing concentration its values increased ($P < 0.05$). In this sense, the values of the inhibition zones ranged from 0.00 ± 0.00 mm (62.5 µL x $L^{-1}$ for *P. citrinum*) to 7.33 ± 1.53 mm (500 µL x $L^{-1}$ for *P. expansum*). A similar increasing trend was also observed in in situ analyzes where SCEO displayed the most effective inhibitory effectiveness against *P. expansum* (250 and 500 µL x $L^{-1}$) growing on a slice of bread.

Finally, the use of the SCEO in the vapor phase against the growth of *Penicillium* strains appears to be a promising alternative to the substitution of chemical inhibitors used to extend the shelf-life of bakery products during their storage.

***Key words***: *Essential oil, Salvia sclarea, Chemical composition, DPPH assay, Antifungal activity, Bread.*