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STUDY OF THE BIOLOGICAL ACTIVITY OF ESSENTIAL OILS-WATER MIXTURES

N. Lazarova-Zdravkova, D. Tsanova*, Y. Stoyanova*, Ch. Chilev**, N. Georgieva*, D. Peshev***

*Department of Biotechnology, Faculty of Chemical and System Engineering, UCTM, Sofia, Bulgaria
**Department of Chemical Engineering, UCTM, Sofia, Bulgaria

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Aim

This study aimed to investigate the biological activity of aqueous mixtures of two essential oils. The mixtures were prepared by mixing certain amounts of lavender and clove oils with distilled water at room temperature. In the case of lavender oil, a relatively clear saturated aqueous phase was obtained after mixing with excess of the essential oil. The clove oil formed stable oil-in-water emulsions.

Materials and methods

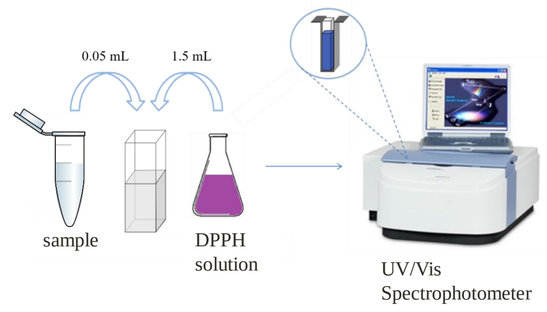

Figure 1. Schematic representation of the DPPH scavenging assay.

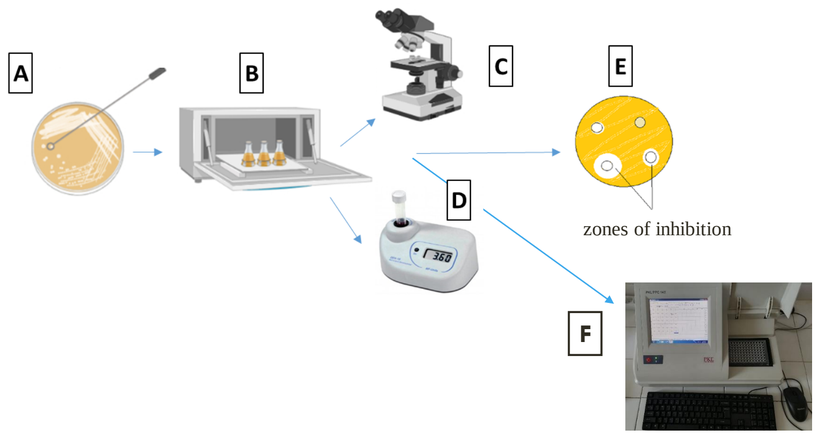

Figure 2. Schematic representation of the antibacterial experiments – inoculation with a single colony (A), cultivation of the strains in an orbital shaker (B), microscopic observation of the culture (C), adjusting of the bacterial culture using a densitometer (D), disk diffusion test (E), broth microdiltuon method – the 96-well microplates were analysed by a Microplate Reader (F).

Results

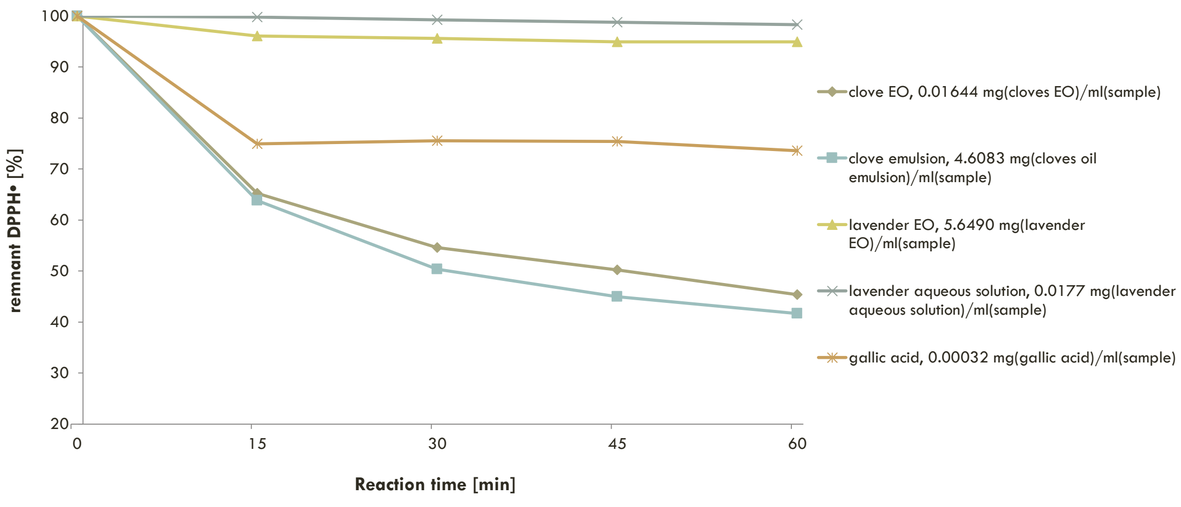

Figure 3. Kinetics of the characteristic radical scavenging reaction of lavender and clove essential oil (EO), lavender aqueous solution, cloves oil emulsion and gallic acid with DPPH•.

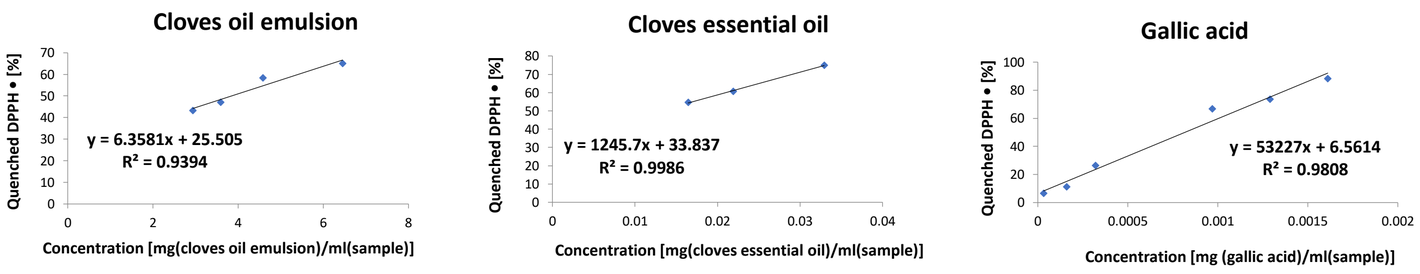

Figure 4. Experimental data and curve fitting for DPPH• quenching for 60 min by cloves oil emulsion (A), cloves essential oil (B) and gallic acid (C) versus concentration of antioxidant in the samples.

The antioxidant power was also characterized by the EC_{50} value: EC_{50} (A) = 3.852566 mg(cloves oil emulsion)/ml(sample); EC_{50} (B) = 0.012975 mg(cloves essential oil)/ml(sample); EC_{50} (C) = 0.000816 mg(gallic acid)/ml(sample).

Table 1. Broth microdilution test results.

Bacterial strain	Lavender aqueous solution						Cloves oil emulsion											
	Concentration [mg(lavender AS*)/ml (sample)]						Concentration [mg(cloves OE**)/ml(sample)]											
	0.37		0.28		0.25		2.33		1.94		1.56		0.37		0.28		0.25	
	6 h	24 h	6 h	24 h	6 h	24 h	6 h	24 h	6 h	24 h	6 h	24 h	6h	24 h	6 h	24 h	6 h	24 h
B. subtilis 3562	Growth reduction [%]																	
	0	0	0	0	0	0	96	96	78	49	42	40	30	27	30	11	28	7
E. coli K12	0	32	0	25	0	25	98	94	97	81	78	76	29	0	25	0	11	0

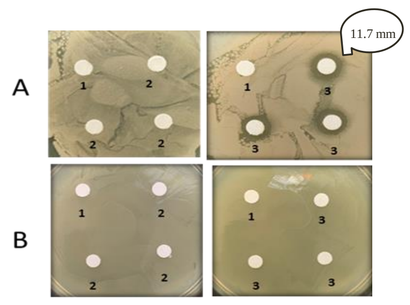

Figure 5. Antibacterial test results of lavender samples against *B. subtilis* 3562 (row A) and *E. coli* K12 (row B) – control (1), lavender aqueous solution (2), lavender essential oil (3).

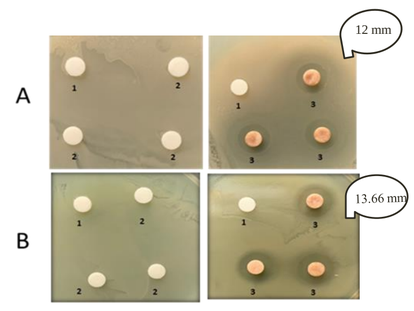

Figure 6. Antibacterial test results of cloves samples against *B. subtilis* 3562 (row A) and *E. coli* K12 (row B) – control (1), cloves oil emulsion (2), cloves essential oil (3).

Conclusions

- Cloves essential oil and its oil-in-water emulsion have relatively higher biological activity compared to lavender essential oil and its aqueous solution.
- The microdilution assay indicated more prominent inhibition activity against *E. coli* K12 strain in comparison to *B. subtilis* 3562 for both oil-water mixtures.
- The disk diffusion test confirmed the greater inhibition of the *E. coli* K12 growth with cloves oil while lavender oil inhibited only the Gram-positive strain.
- Significant antioxidant activity was observed for the cloves essential oil and its emulsion.
- All of our findings suggest that the aqueous by-products obtained during the cloves essential oil production are good candidates for future applications as preservatives in the cosmetics, food and pharma industry.
- The antioxidant activity of cloves essential oil aqueous fractions can be used as an indicator of their essential oil concentration.

Acknowledgements

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