University of Zabol
Graduate School
Faculty of Agriculture
Department of Plant Protection

The Thesis Submitted for the Degree of M.Sc

(in the field of Plant Pathology)

Title:

Antifungal and antibacterial activity of Thyme essential oil microcapsules prepared with electrospraying against some wheat pathogens

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Abstract:

The essential oil of Zataria multiflora has antimicrobial and antioxidant properties. This study was performed to fabricate microcapsules containing thyme essential oil with polymer coating and to investigate its antifungal and antibacterial properties against Xanthomonas translucens and Rathayibacter tritici and Fusarium graminearum and Zymoseptoria tritici. To do this, first the essential oil of Zataria multiflora was extracted and a solution of zein and acetic acid was prepared and then microcapsules were produced by electrospray method. After microcapsule production, scanning electron microscopy, transmission electron microscopy, Fourier transform infrared spectroscopy, differential scanning thermal analysis, measurement of porosity and specific surface area and X-ray diffraction analysis were performed. . Then, the efficiency of the amount of essential oil loaded and the antifungal antibacterial activity of the microcapsules were determined using the well diffusion method in agar. The results of SEM test and Image J software showed that the produced microcapsules are uniform, spherical and in the form of red blood cells. TEM results showed that the synthesized spherical microcapsules had a smooth, non-slit surface. In the X-ray diffraction (XRD) test, the resulting microcapsules were amorphous and the microcapsules containing the essential oil did not have any additional peaks, which indicates the compatibility between the essential oil and the zein polymer. DSC calorimeters and FTIR spectra confirmed the presence of Zataria multiflora essential oil in electrospray zein microcapsules. Also, FTIR spectrum showed that the addition of Zataria multiflora essential oil changed the secondary structure of zein protein. The results of BET test showed that with increasing the essential oil, the average diameter of the microcapsules is decreasing-increasing and the decreasing trend that is observed in high concentrations of essential oil can be attributed to the clumping of essential oil in these concentrations. SPSS software version ٢٤ was used for statistical analysis of data and Duncan multi-range test at ٥٪ probability level was used to compare the mean of the data. The effect of different concentrations of microcapsules containing Zataria multiflora essential oil on inhibiting the growth of pathogens studied in this study and creating an aura of growth inhibition was significant. There was also a positive correlation between the concentration of essential oil used and the degree of inhibition of pathogen growth. In general, microcapsules containing thyme essential oil were more effective in inhibiting the growth of fungal colonies than bacteria. The highest inhibition of colony growth was observed in Fusarium isolate and the least inhibition of growth was observed in Xanthomonas strain. In addition, the effect of different concentrations of essential oil on Rathayibacter gram-positive bacteria was greater than that of Xanthomonas gram-negative bacteria.

KEYWORDS: Essential oil, Encapsulation, Electrospraying, Bacterium, Fungus