

Microfluidic control preparation of phoxim microemulsion and its permeation on the epidermis of *Spodoptera litura*

Zong-Nan Li ¹, Yu-Xuan Zhang ¹, Fu-An Wu ^{1, 2, 3, 4, *}, Jun Wang ^{1, 2, 3, 4, *}, Sheng Sheng ^{1, 2, 3, 4}

¹ School of Biotechnology, Jiangsu University of Science and Technology, 212018 Zhenjiang, China;

² Sericultural Research Institute, Chinese Academy of Agricultural Sciences, 212018 Zhenjiang, China;

³ Key Laboratory of Silkworm and Mulberry Genetic Improvement, Ministry of Agriculture, Sericultural Research Institute, Zhenjiang 212018, PR China;

⁴ Jiangsu Key Laboratory of Sericultural Biology and Biotechnology, Zhenjiang 212018, PR China.

* Corresponding author. E-mail: fuword@163.com; wangjun@just.edu.cn (Prof. Dr. F. A. Wu & J. Wang).

Abstract: Microemulsion is a nanometer drug carrier mainly used in medicine. In this study, a microfluidic device was used to prepare the insecticide phoxim microemulsion. The result showed that the best microemulsion composition surfactants were Tween 80 and agricultural emulsifier 500, the oil phase was N-hexyl acetate, and the co-surfactant was N-propanol. In this formula, the water phase and the oil phase in the microfluidic system are set as the upper phase and the lower phase, respectively. In microfluidic system the formula was used, the water phase and the oil phase were set as the upper and lower phases, and the flow rate was 5 and 20 $\mu\text{L}/\text{min}$ respectively. Microemulsion's boiling point/cloud point was 109 °C, particle size was 21.5 ± 0.8 nm, and the potential value was -18.7 ± 0.6 mV. The release amount of microemulsion in vitro was 33.2-52.4 mg/L, the penetration amount to *Spodoptera litura* was 0.9-4.2 mg, and the penetration rate was 8.7-90.7%. These results highlight the potential of microfluidic technology to produce pesticide microemulsions, which can stabilize insecticide molecules on target pests, and provide ideas for the development of new agricultural pesticides.

Keywords: Microfluidic; phoxim; microemulsion; permeation; epidermis; *Spodoptera litura*.