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# OPTIMIZATION OF PLANT EXTRACTS MICROEMULSIONS FOR AGRICULTURAL PEST MANAGEMENT USING MULTICRITERIA ANALYSIS

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Plant extracts have emerged as promising eco-friendly alternatives to synthetic pesticides for managing agricultural pests. Their natural origin reduces environmental impact, toxicity to non-target organisms, and resistance development. However, to maximize their efficacy and stability, the formulation of plant extracts into microemulsions has gained increasing attention. Designing optimal microemulsions involves balancing multiple factors (droplet size, surfactant concentration, stability, insecticidal activity, cost, and environmental safety). This complexity demands a structured approach such as multicriteria decision analysis (MCDA) to select the best formulation tailored for pest management.

Our direction of the research was optimization of preparation and characterization of *Sophora flavescens* root extract as natural insecticide and *Reynoutria sachalinensis* known for its potential as natural fungicide in greenhouses. The studied pests were the most important insects for a large range of plants greenhouse whitefly (*Trialeurodes vaporariorum*) and cucumber powdery mildew. Formulation variables were type and concentration of surfactants and cosurfactants, oil phase selection and active ingredient concentration. The polyphenolic extracts were prepared and analyzed by UV-Vis spectrophotometric method. The content of polyphenols, total flavonoids and alkaloids was evaluated and antioxidant activity was quantified. The extracts were prepared for optimizing in various conditions using different ratios of ethanol, acetic acid, water, temperature, pH and surfactants concentration. Perfor-

mance criteria were biological efficacy (mortality or repellency rates of target pests) and physical stability (resistance to phase separation over time and temperature). The optimal solutions were obtained using OptimClass software that is an interactive system for multi-criteria decision making and evolutionary optimization (*http://ecobionet.com/STA.aspx*).

OptimClass software facilitates a systematic evaluation and selection of optimal formulations. As result a new prepration form of tested extrats was elaboratied. Microemulsions enhance the bioavailability, penetration, and controlled release of active compounds. By integrating multidisciplinary knowledge in chemistry, agronomy, and data analytics through tools like OptimClass, researchers can significantly enhance the design of plant extract microemulsions, facilitating the transition toward sustainable and effective pest management solutions.

**Keywords:** Multicriteria analysis, extracts, optimization, organic agriculture.

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