

Investigation on Plant Growth Promoting Rhizobacteria and Chicken Manure for *Echinacea purpurea* Growth and the Antimicrobial Efficacy of Echinacea Extracts

Julia Liu, Chao-Hsien Lin², and Pearl Pei-Chun Chang^{1*}

¹Department of Tropical Agriculture and International Cooperation, National Pingtung University of Science and Technology, Pingtung, Taiwan ROC

²Department of Cosmetic Science & Institute of Cosmetic Science, Chia Nan University of Pharmacy & Science, Tainan, Taiwan, ROC

³Department of Plant Industry, National Pingtung University of Science and Technology, Pingtung, Taiwan ROC

Echinacea purpurea is a popular medicinal plant used in Europe and North America. Firstly, this study is to determine the feasibility of cultivating *Echinacea* in the tropics and to investigate the effects of chicken manure and plant growth promoting bacteria (PGPR) on the growth and yield of *E. purpurea*. Results showed that chicken manure was effective in promoting plant vegetative growth, and the combination of chicken manure and PGPR showed the most promotion in plant root length and flower yield, with the average flower number reaching 60 per plant. Secondly, fractions extracted from *E. purpurea* leaves, roots, and flowers using different extraction solvents and procedures were tested for the antimicrobial efficacy against four pathogenic strains using paper disc diffusion tests. According to the disc diffusion assay results, little or no antimicrobial activities were observed for fractions extracted with water, hexane, and 70% ethanol. On the contrary, saturated flower fraction extracted with methanol gave rise to inhibition zones of all four tested strains, reaching 14.8, 18.4, 19.7, and 19.0 mm for *Escherichia coli*, *Staphylococcus aureus*, *Streptococcus sobrinus*, and *Candida albicans*. Thirdly, the antimicrobial efficacy of an alcohol-free mouthwash product prototype containing 1.0% the methanol extract was compared with a commercial product in an efficacy assay. Results showed that the *Echinacea* mouthwash prototype reduced *S. sobrinus* counts by 90% in 5 mins.

Key word: *Echinacea purpurea*, Composted chicken manure, Plant growth-promoting rhizobacteria, antimicrobial, mouthwash