

Ammonium Ion Effects on the Yield and Terpenoid Contents of *Chrysanthemum coronarium* L. Grown under Hydroponic System

¹Dept. of Oriental Medicine Materials, Dongshin University, Naju 520-714, Korea;

²Dept. of Biology, Sunchon National University, Suncheon 540-742, Korea; ³Dept. of Crop Science, Jeonnam ARES, Naju 520-715, Korea

Hyo-Shim Han², Dong-Kwan Kim³, Woo-Hyuk Lee¹, Kyung Dong Lee^{1*}

Objectives

Chrysanthemum coronarium L. is one of the most important medicinal plants cultivated in East Asia. Recently, the demands of *C. coronarium* L. are increasing greatly by well-being boom, but there is not enough to meet the researches. The objective of this study was to determine the effect of ammonium ion on the yield and effective components of the plant grown in a deep floating technique(DFT) system under greenhouse conditions.

Materials and Methods

- Treatment and composition of nutrient solution: Plants of *Chrysanthemum coronarium* L. were grown in a hydroponic system with a nutrient solution based on the formulation suggested by the Applied Plant Research, Division Glasshouse Horticulture, the Netherlands. Four grades of ammonium ion concentrations were selected as NH₄⁺treatments; 0, 2.5, 5.0 and 7.5 mM.

- Plant preparations and cultivation: plants were transplanted in the container(60x 40x 15 cm, 18 L per pot) in the deep floating technique(DFT) system. Modified nutrient solutions was circulated continuously by air pump and were grown in a greenhouse under natural light conditions, at a daytime temperature of 25°C and a relative humidity of 65-70%. At harvest the plant characteristics were investigated by the RDA methods.

- Sesquiterpene content and essential oil: Cumambrin A, a major active component of *C. coronarium* L. flowerheads, was analyzed by HPLC(Waters 201, Waters, USA) after CHCl₃ extraction at room temperature for 2 days. The operating conditions were as follows: Adsorbosphere silica 5 μm column and Lamda-max detector; eluent of a dichloromethane: isopropanol(49:1) mixture; column temperature at 25°C; sample size of 5 μl; maximum absorption at 254 nm. The retention times of cumambrin A and dihydrochrysanolide were 6.59 and 13.57 min, respectively. The essential oil content of *C. coronarium*L. was determined with a simultaneous distillation extraction(SDE) apparatus, using the methods by Schultz *et al.*.

.....
*Corresponding author: 이경동(KD Lee) E-mail: leekd@dsu.ac.kr Tel: 061-330-3261

- Statistical analysis: All statistical analysis was conducted by using a one-way ANOVA of the Statistical Analysis System (SAS) computer package.

Results

Our results indicated that growth characteristics and the dry weight of leaves of *C. coronarium* L. decreased significantly with increasing ammonium concentration in nutrient solution. The maximum flowerhead yield was achieved in 1.8 mM of ammonium. Contents of sesquiterpene lactones were increased by increasing ammonium concentration, but yields were decreased by ammonium treatment. Maximum yields of sesquiterpene lactones were achieved in 3.1 mM ammonium concentration ($r=0.976^{***}$). A highly negative correlation ($r=-0.804^{***}$) was observed between sesquiterpene lactone contents and nitrogen content in the flower part. Essential oil yields decreased with increasing ammonium treatment and a high correlation was observed ($r=0.865$, $p<0.001$) between essential oil content and nitrogen content in leaves.

Table 1. Sesquiterpene lactone content and yields of the flowerhead of *C. coronarium* L. cultivated hydroponically at different ammonium levels

NH ₄ ⁺ (mM)	Sesquiterpene lactone content (g kg ⁻¹ , D.W.)			Sesquiterpene lactone yield (mg plant ⁻¹ , D.W.)		
	Dihydro-ch rysanolide	Cumambrin A	Total	Dihydro-ch rysanolide	Cumambrin A	Total
0.0	0.440c ^a	0.878c	1.318c	4.88b	9.75ab	14.63b
2.5	0.625b	0.903b	1.528b	7.69a	11.11a	18.79a
5.0	0.725ab	1.069a	1.792ab	5.86ab	8.66b	14.52b
7.5	0.798a	1.086a	1.884a	1.60c	2.17c	3.77c

^a Mean values within ammonium concentration followed by the same letter are not significantly different according to Duncan's multiple range tests at the 5% level