

## Immunomodulatory effect of total methanol extract from *Codonopsis lanceolata*

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### Objectives

*Codonopsis lanceolata* is known to have a strong anti-cancer and anti-inflammatory activities. In this study, the immunomodulatory effects of total methanol extracts (TME) from roots or leaves of *Codonopsis lanceolata* on macrophage functions were examined, since its molecular immunomodulatory mechanisms are poorly characterized yet.

### Material and Methods

#### ○ Materials

The total methanol extracts (TME) of *Codonopsis lanceolata* were purchased from Plant Diversity Research Center (Daejeon, Korea). FITC-dextran, 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT), Griess reagents, and lipopolysaccharide (LPS) were purchased from Sigma Chem. (St. Louis, MO, USA). RAW264.7 cells were obtained from ATCC (Rockville, MD, USA). Fetal bovine serum, penicillin and streptomycin were obtained from GIBCO (Grand Island, NY, USA)

#### ○ Methods

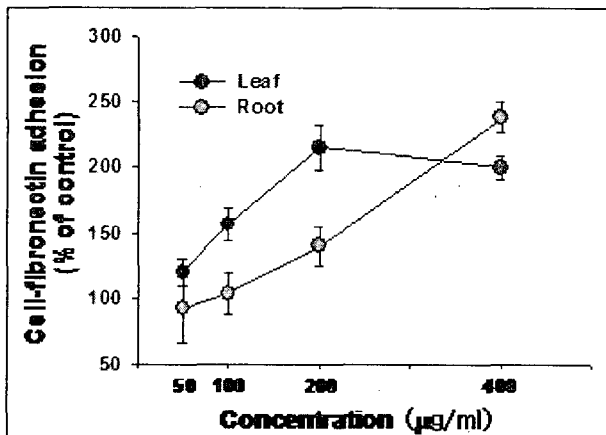
To do these experiments, macrophage-mediated immunological functions such as cytokine production, nitric oxide (NO) production, phagocytosis and cell-fibronectin adhesion were tested according to previous methods (Cho et al., 2000; 2001; 2005) using murine and human macrophage cell lines (RAW264.7 and U937 cells).

### Results and Discussion

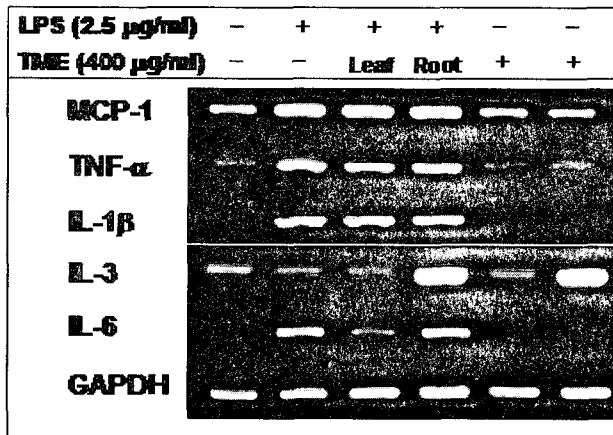
Treatment of root TME (r-TME) enhanced U937 cell-fibronectin adhesion mediated by beta1-integrins, up to 175% (Fig. 1A) and also up-regulated IL-3 expression assessed by RT-PCR analysis (Fig. 1B). In contrast, leaf TME (l-TME) and r-TME significantly blocked NO production in lipopolysaccharide-activated RAW264.7 cells (Fig. 1C), without affecting iNOS expression. Interestingly, r-TME and l-TME showed different modulatory pattern on phagocytic activity of RAW264.7 cells toward FITC-labeled dextran (Fig. 1D). Thus, r-TME increased RAW264.7 cell's phagocytic ability, while l-TME did not. However, TMEs did not alter the expression of other cytokines and chemokines such as TNF- $\alpha$  and MCP-1. Therefore, our data suggest that *Codonopsis lanceolata* may be a good immunomodulatory ethnopharmacological herbal with different immune-regulatory functions.

\* Fig. 1. Effect of total methanol extract (leaf : l-TME and roots : r-TME) from *Codonopsis lanceolata* on cell-fibronectin adhesion, cytokine production, NO production and phagocytic uptake in activated macrophage/monocytes.

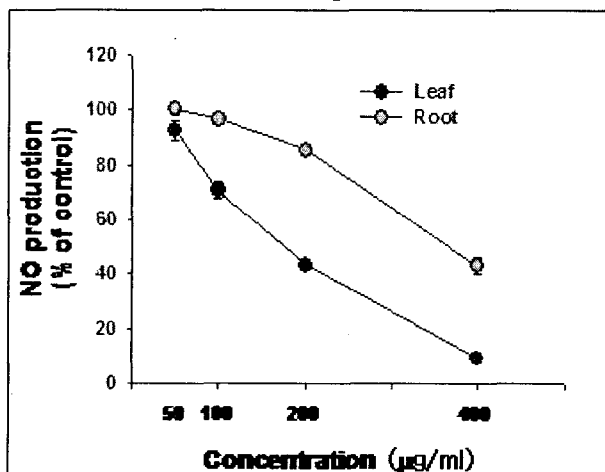
**A. Effect on cell-fibronectin adhesion**



**B. Effect on cytokine production**



**C. Effect on NO production**



**D. Effect on phagocytic uptake**

