

Physicochemical Characterization of Extrudate Solid Formulation of *Angelica gigas* Nakai Prepared by Hot Melt Extrusion Process

Md Obyedul Kalam Azad¹, Hyun Jong Cho², Ja Seong Koo²,
Cheol Ho Park¹ and Wie Soo Kang^{1*}

¹College of Bio-medical Science, Kangwon National University, Chuncheon 24341, Korea

²College of Pharmacy, Kangwon National University, Chuncheon 24341, Korea

The root of *Angelica gigas* Nakai (AGN) is used as a traditional herbal medicine in Korea for the treatment of many diseases. However, a major challenge associated with the usage of the active compounds from AGN is their poor water solubility. Therefore, this work aimed to enhance the solubility of active compounds by a chemical (viz. surfactant) and physical (hot melt extrusion) crosslinking method (CPC). Infrared Fourier transform spectroscopy (FT-IR) revealed multiple peaks in extrudate solids representing new functional groups including carboxylic acid, alkynes and benzene derivatives. Differential scanning calorimetry (DSC) analysis of the extrudate showed lower glass transition temperature (T_g) and lower enthalpy (ΔH) (T_g: 43°C; ΔH : <6 (J/g)) compared to the non-extrudate (T_g 68.5°C; ΔH : 123.2) formulations. X-ray powder diffraction (XRD) analysis revealed amorphization of crystal materials in extrudate solid. In addition, nanonization, enhanced solubility and higher extraction of phenolic compounds were achieved in the extrudate solid. Among the different extrudates, acetic acid- and Span 80-mediated formulations showed superior extractions. We conclude that the CPC method successfully enhanced the production of amorphous nano dispersions from extrudate solid formulations.

Key words: Bioactive herbal compounds, *Angelica gigas* Nakai, Nano solid dispersion, Size reduction, Hot melt extrusion