

## Quantitative determination of 27 ginsenosides in raw ginseng (*Panax ginseng* C. A.) and steamed ginseng by LC-MS/MS

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**P**anax ginseng has been used in traditional medicine to strengthen immunity, provide nutrition, and reduce fatigue. The anti-cancer, anti-inflammatory, and anti-proliferative effects of P. Ginseng are attributed to ginsenosides found in the plant, which contains 4-10% of ginsenosides. Steamed red ginseng was known to enhance the above beneficial effects on health. Steaming and drying process generated hydrolyzed ginsenosides which are more pharmaceutically active. Nine repeated steaming and drying processes have been adopted to maximize the hydrolysis in household scale industry. The quality of those products is not guaranteed in Korean market. Therefore, high through put and reliable analytical method to quantify a wide variety of ginsenosides in complex biological samples is essential to protect consumer. In this study, we present multi-ginsenoside quantification method using tandem quadrupole mass spectrometry to measure the amount of various ginsenosides profiles in raw, singly steamed, and 9 repeatedly steamed ginseng. Methanolic extract only after large volume dilution was directly subject to LC-MS/MS without any sample clean-up. The more sample was diluted, the less ionization was affected by matrix at the ion source. Therefore, enhancement of sensitivity was a key to accurate quantification. Since the molecule of ginsenosides contain different number of glycosyl group to propanaxdiol and protopanaxtriol, ginsenosides have characteristic ionization pattern depending on the glycosyl group. The sensitivity was improved by the selection of different ionizations, such as the deprotonated, acetate adducts, and doubly charged ion. Some ginsenosides including Rd, Re, and Ro had weak intensity of fragment ions via collision aided dissociation, which led to high detection limit. In these cases, pseudo ion transition, molecular ion to molecular ion were tried to make up the bad sensitivity. The developed method was validated for precision, repeatability, reproducibility, accuracy, linearity, apparent recovery, and expanded measurement uncertainty in raw and steamed ginsengs. The intra and inter day repeatability was less than 3%. The limit of detection ranged from 5.0 to 45 ug/kg. In the time course of steaming and drying, ginsenoside Rb1, Rb2, Rc, Rd, Re, Rf, and Rg1 decreased, but ginsenoside Rg3, Rh2, compound K and F2 increased. Especially, the increased amount of Rg3 and F2 was remarkable in nine repeated steamed and dried black ginseng. Multivariate statistical method such as principal component analysis enables us to identify quality control ginsenoside, Rg3.

### Biography

Jongsung Ahn has completed his Ph.D from Chonbuk National University, Korea and received fellowship for 2 years' research experiences at Food & Environment Research Agency in the UK and Friedrich Alexander University in Germany. He is the leader of analytical team at National Agricultural Products Quality Management Service, Korean governmental entity. He has published more than 10 papers in reputed journals.

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