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## FISH and GISH analysis of the genomic relationships among *Panax* species

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### FISH와 GISH 기법을 이용한 인삼의 계통 분석

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### Objectives

Ginseng is a well-known medicinal herb in the world. In the genus *Panax*, only three species, *P. ginseng* (Oriental or Korean ginseng), *P. quinquefolius* (American ginseng) and *P. notoginseng* (Chinese ginseng), are currently considered to be important medicinal herb. Despite the increase in their breeding value, molecular cytogenetic information on the species is not available. This work was conducted to analyze the genomic relationships among the *panax* species using FISH and GISH techniques.

### Materials and Methods

#### 1. Materials

*P. ginseng* C.A Meyer  
*P. notoginseng* (Burkill) F.H.  
*P. japonicus* C.A Meyer  
*P. quinquefolius* L  
Korean mountain ginseng

#### 2. Methods

FISH (fluorescence *in situ* hybridization)

-45S rDNA probe; labeled with biotin-16-dUTP using the specific 17S rDNA primers.

-5S rDNA probe; labeled with digoxigenin-11-dUTP using the specific 5S rDNA primers.

GISH (genomic *in situ* hybridization); labeled with Nick Translation Mix and genomic DNA.

detection of probes; avidin-FITC (green) / anti-dig rhodamine (red) / DAPI (blue)

### Results and Discussion

FISH was used to analyze the variability of ribosomal DNA loci on the metaphase chromosomes of the *Panax* species. Diploid *P. notoginseng* had each one pair of 45S

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and 5S rDNA loci. However, variation in rDNA locus number was found in tetraploid *Panax* species. In *P. ginseng*, each locus of 45S (green signals) and 5S rDNA (red signals) was detected on the short arm of a submetacentric chromosome pair and on the short arm of another submetacentric chromosome pair, respectively. In contrast, *P. quinquefolius* had one pair of 45S rDNA locus and two pairs of 5S rDNA loci on the same position as in the chromosomes of *P. ginseng*. Other tetraploids, *P. japonicus* and Korean wild ginseng, also had the same FISH patterns of the rDNA locus as that of *P. quinquefolius*.

GISH was used to elucidate the genomic relationships, such as the degree of genomic homology and its diversification among the *Panax* species. The genomic DNA probe of diploid *P. notoginseng* labeled with biotin-16-dUTP was not hybridized to the genome of *P. ginseng* or *P. quinquefolius*. When the genomic DNA probe of tetraploid *P. quinquefolius* was applied to the chromosomes of *P. ginseng*, it strongly hybridized. The genomic DNA probe of tetraploid Korean wild ginseng was also strongly hybridized to that of *P. ginseng*, but it did not show strong hybridization on the genome of *P. quinquefolius*. GISH of *P. ginseng* with the probe of *P. japonicus* did not work.