Discrimination of geographical origin, cultivation years and evaluation of medicinal components in ginseng using near infrared spectroscopy

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Introduction

The geographical origin and cultivation period have always been considered very important in quality grading of ginseng radix. A rapid and non-destructive discriminant analysis for the origin and the age of ginseng radix is now required.

The aim of this study is to investigate the feasibility of discrimination of geographical origin, cultivation years and evaluation of medicinal components in ginseng using near infrared (NIR) spectroscopy. Whole ginseng radix, cultivated for four to seven years in Korea and China were used as separate samples. NIR spectra were measured using a scanning-type NIR instrument together with a fibre optic and filter-type NIR instrument.

Discriminant analysis for geographical origin of whole ginseng radix resulted in high accuracy of *c*. 93%. In the case of sliced ginseng, discrimination for cultivation years was *c*. 97% accurate.

There were serious differences in total saponin content between Korea and China ginseng, but no relationship between five and six years old Korean ginseng. Further, lignin content was also higher in Korean ginseng than that of Chinese ginseng and showed a difference in content in cultivation years. It was also possibile to measure the Ginsenoside of Rbl, Rb2, Rc, Re and Rgl using the NIR spectra of whole Ginseng roots.

The results show that it is possible to use NIR spectroscopy for discrimination of geographical origin, cultivation years and evaluation of medicinal component in ginseng.

Materials and methods

White ginseng sample preparation

1. White ginseng roots : produced in korea and china from 1994-1997
2. White ginseng tablet
3. White ginseng powder

Chemical analysis

1. Saponin content was measured by HPLC
ginseng powder 5 g → extraction (100% MeoH, 60°C, 1hr) → aspiration → C18 Sep-pak → HPLC
2. Lignin content

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NIR alalysis

1. Instrument : InfraAlyzer 500, 450, 260, fiber optic(Bran + Luebbe)
2. Data analysis: IDAS program (Bran + Luebbe).

Results

Table 1. Result of ginseng geographical origin discriminant (IA 500).

Sample	Instrument	Terms	Accu racy
Root	1A500 1A450	4 9	95.8 91.7
Tablet	1A500 1A450	4 9	90.6 85.4
Powder	1A500 1A450	2 2	96.6 93.0

Table 2. Result of ginseng geographical origin discriminant(IA 450).

Sample	Instrument	Terms	Accuracy
Root	1A500 1A450	4 9	95.8 91.7
Tablet	1A500 1A450	4 9	90.6 85.4
Powder	1A500 1A450	2 2	96.6 93.0

Table 3. Result of ginseng geographical origin discriminant(IA 260).

Sample	Terms	Correct	Incorrect	Accuracy(%)
Root	9	88	8	91.7
Tablet	9	82	14	85.4
Powder	2	80	6	93.0

Table 4. Result of years of ginseng radix(IA 260).

Prediction sample set	Discriminant			Accuracy (%)
	4 year	5 year	6 year	
4 year	50	24	22	52.1
5 year	20	31	17	45.6
6 year	17	4	61	74.4

*Used wavelength (nm): 1912, 1954, 2458 and 2500 nm

Table 5. Result of years of ginseng radix using tablet.

Prediction Sample set	Discriminant			Accuracy (%)
	4 year	5 year	6 year	
4 year	29	1	0	96.7
5 year	1	21	1	91.3
6 year	2	1	25	89.3

Used wavelength (nm) : 1156, 1170, 2444 and 2500 nm

Table 6. Result of years of ginseng radix using fibre optic.

Sample	Used wavelengths (nm)	Accuracy(%)		
		4 year	5 year	6 year
Root	1870, 1881, 1892	40.0	42.9	81.8
Tablet	1859, 1870, 1881, 1892	60.0	53.6	81.8
Powder	1814, 1842, 1856, 1898	75.2	67.0	80.1

Table 7. Results of ginsenoside analysis of ginseng.

Ginsenoside	Korea		China	
	5 year	6 year	6 year	7 year
Rbl	15.76	16.02	6.97	8.61
Rb2	5.35	5.16	2.91	3.86
Rc	7.86	7.53	3.88	5.85
Rd	1.94	1.96	1.11	2.12
Re	10.68	9.97	3.72	4.16
Rgl	19.91	18.46	8.77	10,08

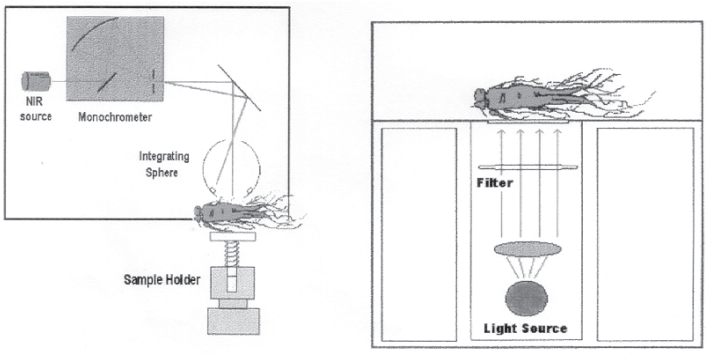

Figure 1. NIR measuring of ginseng root by IA500 and IA540.

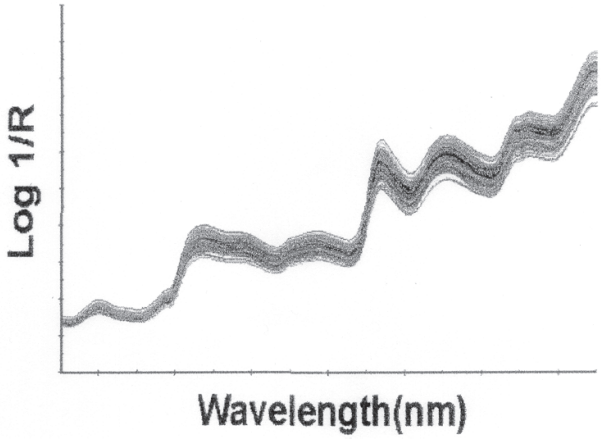

Figure 2. NIR spectra of ginseng root by IA500.

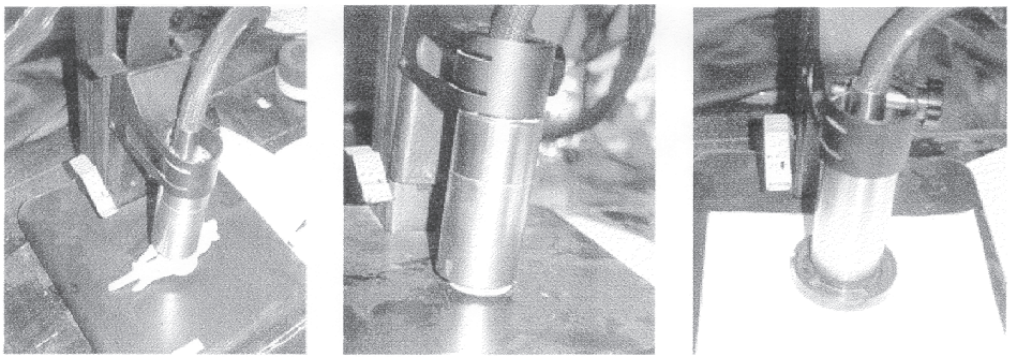

Figure 3. NIR measuring of ginseng radix using a fibre optic.

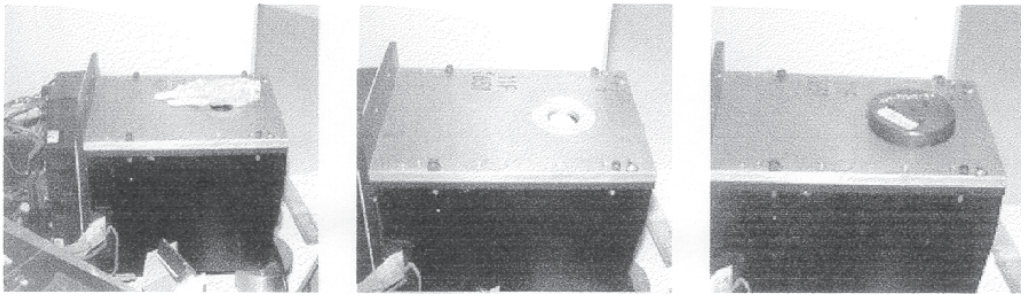

Figure 3. NIR measuring of ginseng radix using a fibre optic.

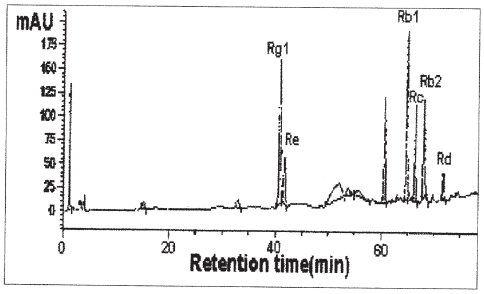

Figure 5. Saponin analysis of ginseng by HPLC.

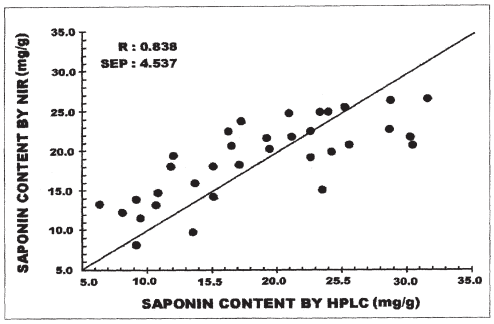

Figure 6. Plot of predicted v. Measured saponin content of ginseng.

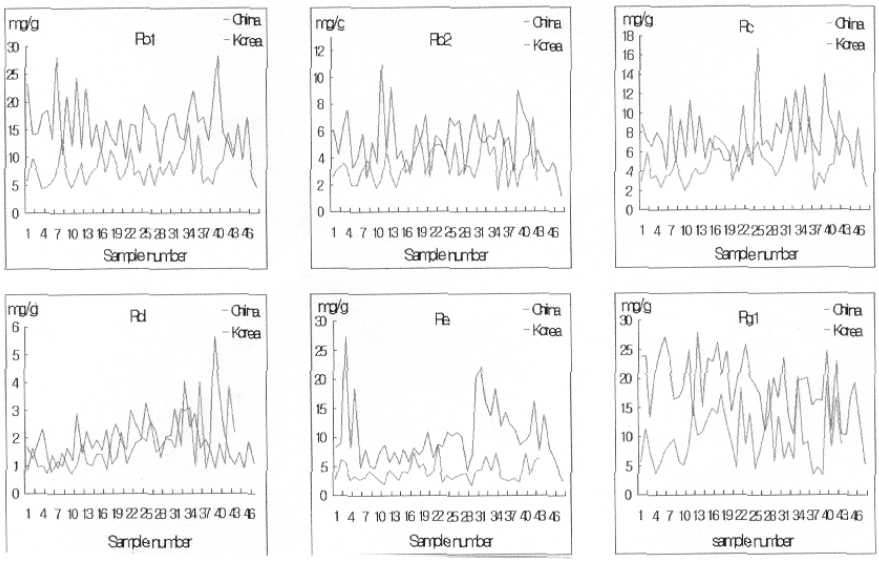

Figure 7. Comparison of ginsenoside content between Korean and Chinese ginseng.

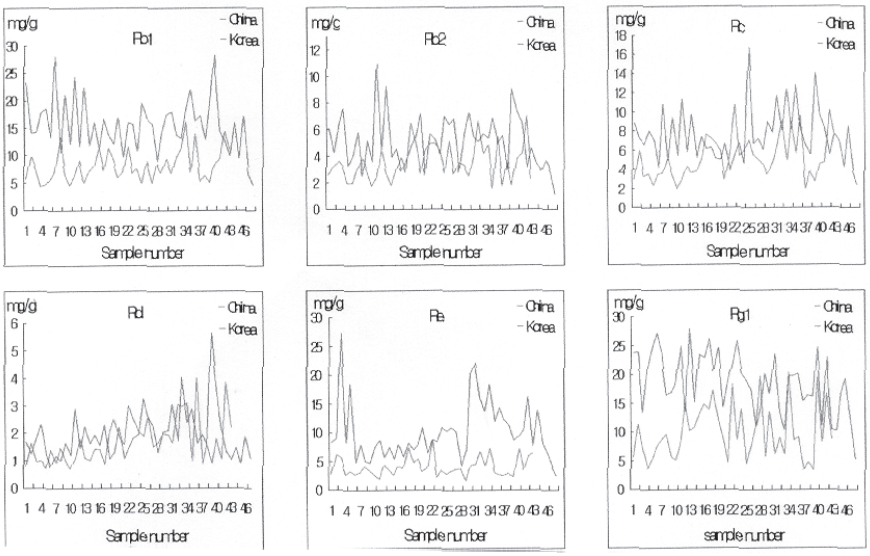

Figure 8. Comparison of ginsenoside content of the Korean ginseng in the cultivation years.

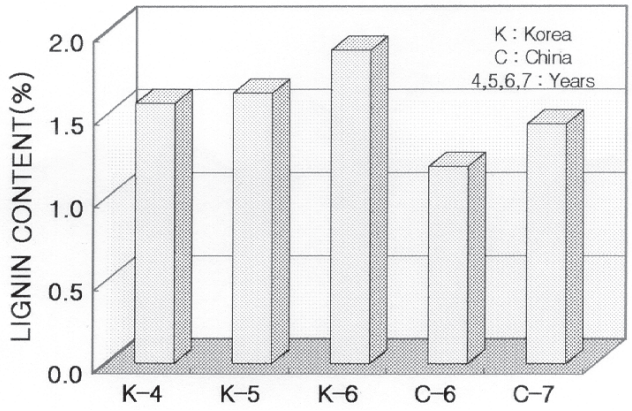

Figure 9. Lignin analysis of Korean and Chinese ginseng.