

The identification of the country of origin of high value agricultural products by near infrared spectroscopy

Young Kil Kwon and Rae Kwang Cho

Department of Agricultural Chemistry, Kyungpook University, Taegu 702–701, Korea.

Satoko Yasumoto

Agricultural Research Center, Tsukuba 305, Japan.

Introduction

In the previous conference in this series (NIR94), we presented a paper on the applicability of near infrared (NIR) spectroscopy for the determination of moisture content, crude saponin and ginsenosides in Korean ginseng products.¹

During the Koryo Dynasty (AD 918–1392), there were two kinds of ginseng product, sundried and steamed ginseng. The conventional sun-drying method was changed to the steaming method to meet an increased demand for the product.

The steaming technique was originally developed by the Koreans around 1080 to preserve the quality of ginseng and this was the start of the production of Korean Red ginseng—Korean ginseng has a slightly reddish brown color.

In 1606, during the Yi Dynasty, non-governmental dealing in ginseng was strictly prohibited by the Ministry of Finance in order to prevent smuggling. Thereafter, ginseng trading was controlled by the issuing of certificates to traders. In 1908, the management of the red ginseng monopoly was taken over by the Ministry of Finance.

We have reported elsewhere the applicability of NIR spectroscopy for the determination of the purity of sesame oil products to help eliminate unlawful trading or smuggling due to price differentials.²

In recent years, the need for an ultra-fast, simple, non-destructive inspection technique for identifying the geographic origin and for determining the quality of agricultural commodities has become of increasing importance in many countries.

The present study describes the development of a method for identifying the country of origin of ginseng and sesame seeds using NIR spectroscopy.

Materials and methods

Samples

Over 1500 roots of dried ginseng, red ginseng and Taeguk ginseng roots produced in Korea and China were purchased. Domestic and imported sesame seeds were provided by the Korean Agricultural Product Inspection Center. Near infrared reflectance spectra of three kinds of ginseng

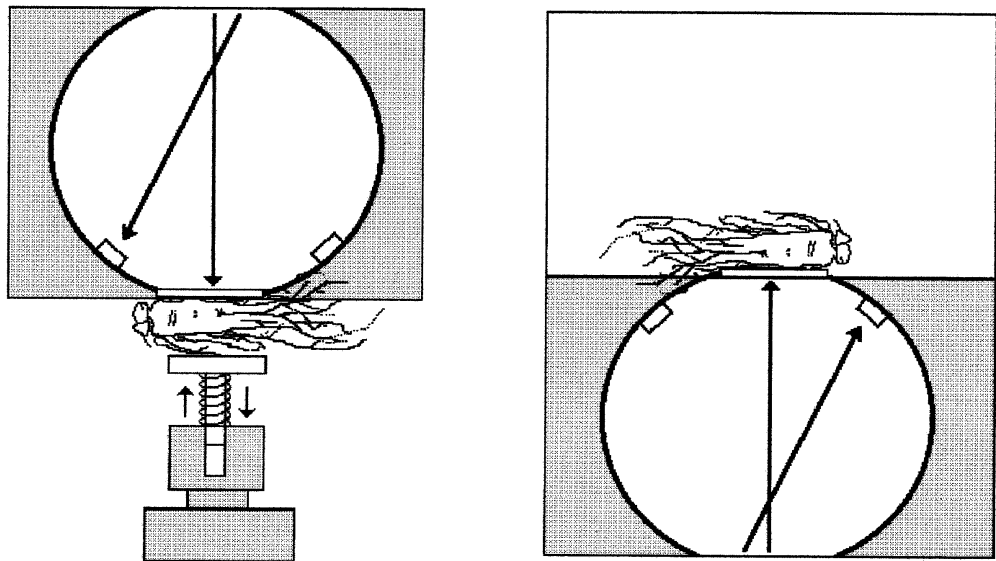


Figure 1. Sample presentation using two kinds of sample loader for ginseng root.

Table 1. Results of identification for the country of origin of ginseng root.

		White ginseng	Taeguk ginseng	Red ginseng
Accuracy	IA-500	93	99	96
%	IA-400	92	99	95

Table 2. Results of identification for the country of origin of sesame seeds.

		Sesame
Accuracy	IA-500	99
%	IA-400	99

root and sesame seeds were measured using an InfraAlyzer 500 and an InfraAlyzer 400 (Bran+Luebbe).

Sample presentation

Two types of sample loader were developed to simplify the sample presentation of ginseng roots, as shown in Figure 1. In the case of sesame seeds, a closed cup (Bran+Luebbe) was adapted using the normal drawer system, but only half of the volume of the sample was used to prevent extraction of the oil substance.

Table 3. Summarized data example from the IDAS-UTIL program.

Result of White ginseng			
2 Wavelength Incorrect data: 70 Percentage: 81.2%	Total data: 372 Correct data: 302	6 Wavelength Incorrect data: 32 Percentage: 91.4%	Total data: 372 Correct data: 340
3 Wavelength Incorrect data: 44 Percentage: 88.2%	Total data: 372 Correct data: 328	7 Wavelength Incorrect data: 30 Percentage: 91.9%	Total data: 372 Correct data: 342
4 Wavelength Incorrect data: 43 Percentage: 88.4%	Total data: 372 Correct data: 329	8 Wavelength Incorrect data: 31 Percentage: 91.7%	Total data: 372 Correct data: 341
5 Wavelength Incorrect data: 38 Percentage: 89.8%	Total data: 372 Correct data: 334		
Result of Taeguk ginseng			
2 Wavelength Incorrect data: 15 Percentage: 84.4%	Total data: 96 Correct data: 81	5 Wavelength Incorrect data: 3 Percentage: 96.9%	Total data: 96 Correct data: 93
3 Wavelength Incorrect data: 4 Percentage: 95.8%	Total data: 96 Correct data: 92	6 Wavelength Incorrect data: 3 Percentage: 96.9%	Total data: 96 Correct data: 93
4 Wavelength Incorrect data: 1 Percentage: 99.0%	Total data: 96 Correct data: 95	7 Wavelength Incorrect data: 3 Percentage: 96.9%	Total data: 96 Correct data: 93
Result of Red ginseng			
2 Wavelength Incorrect data: 17 Percentage: 90.1%	Total data: 172 Correct data: 155	6 Wavelength Incorrect data: 9 Percentage: 94.8%	Total data: 172 Correct data: 163
3 Wavelength Incorrect data: 19 Percentage: 89.0%	Total data: 172 Correct data: 153	7 Wavelength Incorrect data: 7 Percentage: 95.9%	Total data: 172 Correct data: 165
4 Wavelength Incorrect data: 14 Percentage: 91.9%	Total data: 172 Correct data: 158	8 Wavelength Incorrect data: 9 Percentage: 94.8%	Total data: 172 Correct data: 163
5 Wavelength Incorrect data: 12 Percentage: 93.0%	Total data: 172 Correct data: 160		

Data analysis

Discriminant analysis was conducted using the InfraAlyzer Data Analysis Software (IDAS) program (Bran+Luebbe). IDAS-UTIL software was developed and used; this software simplifies the IDAS program, for instance allowing fast input of sample information, automatic sample group division for discriminant analysis, fast summaries and a brief report of the calibration or validation results on a single sheet of paper.

Results and discussion

The results of discriminant analysis for identifying the country of origin of ginseng root and sesame seeds are shown in Tables 1 and 2, respectively. An example of the summarized results from the IDAS-UTIL program is shown in Table 3. Using a 7, 4 and 7 term equation for driedwhite ginseng, Taeguk ginseng and red ginseng, the identification accuracy for the country of origin was about 95%. From a comparison of the results obtained from the InfraAlyzer 500 and InfraAlyzer 400, we suggest that a commercial filter-type NIR instrument with a modified sample chamber can be employed to identify the country of origin of ginseng and sesame seeds on site.

References

1. R.K. Cho and K.H. Lee, *Leaping Ahead with NIR Spectroscopy*, Ed by G.D. Batten, P.C. Flinn, L.A. Welsh and A.B. Blakeney. Royal Australian Chemical Institute, Melbourne (1994).
2. R.K. Cho and M. Iwamoto, *Proceedings of the 2nd International NIR Spectroscopy Conference*, Tsukuba, Japan, Ed by M. Iwamoto and S. Kawano. Korin Publishing Co., Tokyo (1989).