Identification of the geographical origin of sesame seeds by near infrared spectroscopy

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The geographical origin of the Korean, Chinese and Japanese sesame seeds were identified with high accuracy, over 98%, by NIR spectroscopy. The filter-type NIR instrument of showed the same accuracy as the monochromator scanning type to identify the geographical origin of the sesame seeds. In case of adulteration between the Korean and Chinese sesame seeds, the mixed ratio could be determined to about a 10% error level. In this conference, we would like to show how NIR identified geographical origins. Generally, sesame seeds have been consumed as sesame oil from roasted sesame over 200°C. Discriminant analysis, using the NIR spectrums of Chinese and Korean sesame oil, was conducted on the oil cake samples. The accuracy of discrimination was poor in the samples of oil and fitler cakes. We presume that the reason for this was the irregular roasting treatment and chemical change in protein and other constituents during roasting. Next, we extracted raw sesame oil using ethyl ether without heat treatment. The discriminant results showed different accuracies between sesame oil and filter cakes. In the case of raw sesame oil, the accuracy was similar to the heat-treated sesame oil, but the filter cake, after solvent extraction, showed an accuracy of 92.5%. The reason for this was, presumably, the differences of the major substances in the filter cake, such as nitrogenous compounds or carbohydrates.

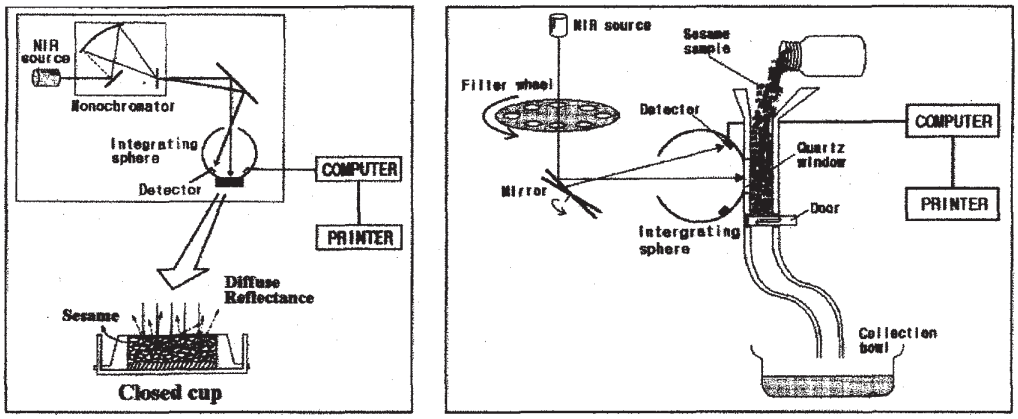

Figure 1. Scheme of NIR spectrum measurement of sesame seed using scanning type (a) and filter type (b) NIR measurments

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Table 1. Result of discriminant analysis for geographical origin using raw spectra data of Korean and Chinese sesame seeds by scanning type NIR instrument.

Used wavelengths (nm)	To/ From	Korean	Chinese	Total[a]	Accuracy %
2010, 2024	Korean	18	1	19	95
	Chinese	2	8	10	80
1716, 1730, 2206	Korean	19	0	19	100
	Chinese	0	10	10	100
1716, 1730, 2206, 2430	Korean	19	0	19	100
	Chinese	0	10	10	100

[a]Total number of samples

Table 2. Result of discriminant analysis for geographical origin using raw spectra data of Korean, Chinese and Japanese sesame seeds by scanning type NIR instrument.

Used wavelengths (nm)	To/ From	Korean	Chinese	Japanese	Total	Accuracy (%)
2010, 2024	Krean	17	0	2	19	89
	Chineseo	3	7	0	10	70
	Japanese	2	0	9	11	82
1548, 1702, 1786	Korean	19	0	0	19	100
	Chinese	1	9	0	10	90
	Japanese	0	0	11	11	100
1702, 1758, 2010, 2024	Korean	19	0	0	19	100
	Chinese	2	8	0	10	80
	Japanese	0	0	11	11	100

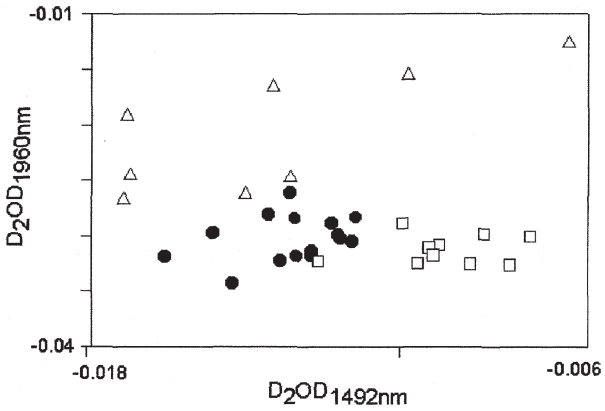

Figure 2. Result of discriminant analysis for geographical origin using second derivative NIR spectral data of the Korean (●) Chinese (□) and Japanese (Δ) sesame seeds.

Table 3. Result of discriminant analysis for geographical origin using raw spectra data of Korean, Chinese and Japanese sesame seeds by filter type NIR instrument

Used wavelengths (nm)	To/ From	Korean	Chinese	Japanese	Total	Accuracy (%)
1680, 1722, 1734, 2230, 2270	Korean	19	0	—	19	100
	Chinese	0	10	—	10	100
1680, 1722, 1760, 1778	Korean	19	0	0	19	100
	Chinese	1	9	0	10	90
	Japanese	0	0	11	11	100

Table 4. Result of discriminant analysis for geographical origin using raw spectra data of Korean, Chinese and adulterated sample of those sesame seeds by scanning type NIR instrument

Used Wavelengths (nm)	To/ From	Korean	Mixture	Chinese	Total	Accuracy %
2010, 2024	Korean	16	3	0	19	84
	Mixture	23	61	16	100	61
	Chinese	2	2	6	10	60
2010, 2024, 2122	Korean	12	7	0	19	63
	Mixture	8	84	8	100	84
	Chinese	1	2	7	10	70
2010, 2024, 2066, 2122	Korean	12	7	0	19	63
	Mixture	8	83	9	100	83
	Chinese	0	3	7	10	70
2010, 2024, 2094, 2360, 2388	Korean	12	7	0	19	63
	Mixture	7	85	8	100	85
	Chinese	0	4	6	10	60
2010, 2024, 2164, 2178, 2220, 2262	Korean	13	6	0	19	68
	Mixture	8	88	4	100	88
	Chinese	1	2	7	10	70

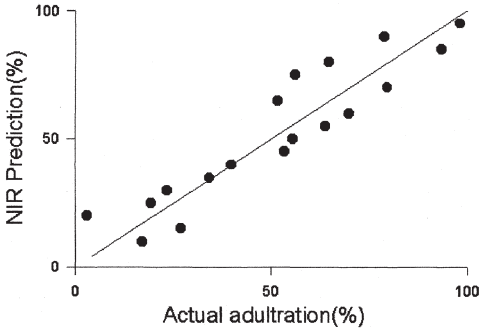

Figure 3. Relationship between NIR prediction and actual adulteration of the Chinese sesame in the Korean sesame seed.

Table 5. Result of discriminant analysis for geographical origin using raw spectra data of oil substances from roasted Korean and Chinese sesame seeds and those oil cakes by scanning type NIR instrument.

	Pre treatment	Used wavelengths (nm)	To/ From	Korean	Chinese	Total	Accuracy %
Roasting sesame oils	Raw[a]	1660, 1758, 1772	Korean Chinese	14 4	9 8	23 12	6.29
	D2[b]	2290, 2360	Korean Chinese	14 2	9 10	23 12	68.6
Roasting sesame oil cakes	Raw	1492, 1814, 1842, 2276, 2304	Korean Chinese	15 0	9 13	24 13	75.7
	D2	1520, 1716, 1828, 2304	Korean Chinese	14 2	10 11	24 13	67.6

[a]Raw spectrum
[b]Second derivative spectrum

Table 6. Result of discriminant analysis for geographical origin using raw spectra data of oil substances from Korean and Chinese sesame extracted with ethyl ether and those oil cakes by scanning type NIR instrument.

	Pre treatment	Used wavelengths (nm)	To/ From	Korean	Chinese	Total	Accuracy %
Ether-extracting sesame oils	Raw[a]	1688, 1702, 2262, 2276, 2458	Korean Chinese	19 3	4 9	23 12	80.0
	D2	11170, 1660, 1688, 2248	Korean Chinese	12 3	11 9	23 12	52.5
Ether-extracting sesame oil cakes	Raw	14781 1506, 1520, 1632	Korean Chinese	22 1	1 11	23 12	94.3
	D2	1492, 1898, 2038, 2136	Korean Chinese	20 0	3 12	23 12	92.5

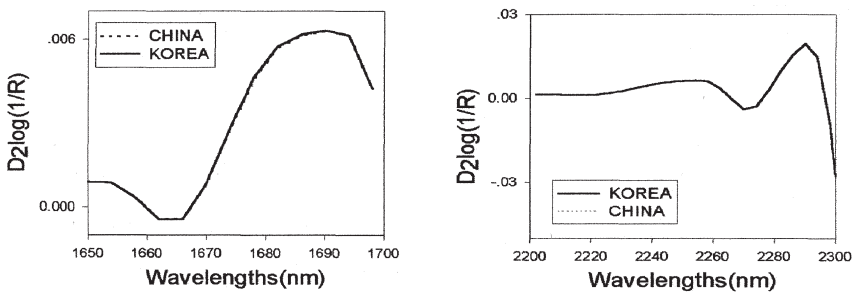

Figure 4. Differences between the average second derivative spectra of the Korean and Chinese sesame oil extracted by ethyl ether.

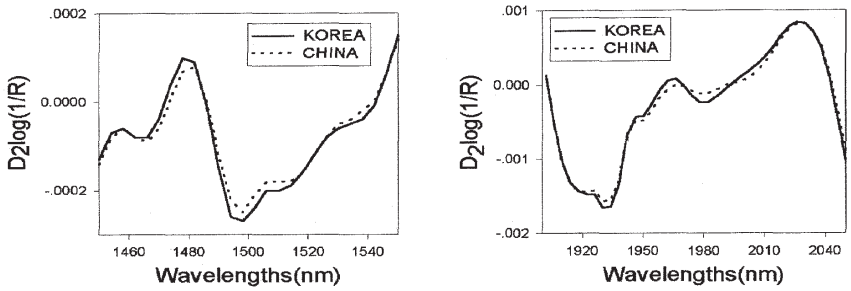

Figure 5. Differences between the average second derivative spectra of the Korean and Chinese sesame oil cake extracted by ethyl ether.

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