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Infrared Spectrum Analysis of Pepper

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Abstract: The infrared spectrum method was used to determine the pepper in different areas and varieties. It is found that infrared spectroscopy can be used as a simple and convenient identification method for Zanthoxylum bungeanum from different areas, at the same time, the two-dimensional and three-dimensional processing methods of infrared spectral data can enhance the recognition ability of the spectrum, which is more conducive to the identification of pepper species.

1. Introduction

Pepper has been used as a seasoning in China for more than 2,000 years. There are more than 20 provinces and autonomous regions in China, including Sichuan Hanyuan, Chongqing Jiangjin, Shaanxi Hancheng and Fengxian. Main producing area of pepper. In recent years, with the adjustment of agricultural structure, the pepper industry in various regions has been developing greatly. According to the data, the planting scale of Zanthoxylum bungeanum increases by 20%-30% annually, forming a huge characteristic industry with an annual output value of about 1.5 billion yuan. The development of pepper is quite fast, and there are more and more researches on pepper. Fourier transform infrared spectroscopy is a commonly used analytical method for structural identification of organic compounds and has been widely used in various research fields.For a mixture system, the peak shape, peak position and peak intensity of its molecular vibration spectrum represent the signal of various corresponding groups in the system. Changes in the composition of the mixture will directly lead to changes in the overall spectrum of the molecular vibrational spectrum, but still maintain the macroscopic fingerprint of the spectrum, so infrared spectroscopy is increasingly used in medicine, food, chemicals, agriculture, tobacco. Identification of the authenticity of the field [1]-[3]. In this paper, the pepper seeds and shells in the same place, the pepper seeds in different places and the pepper shells in different places were studied, and they were identified and distinguished by comparing their characteristic absorption peaks of infrared spectrum and two-dimensional and three-dimensional distribution maps.

2. Test instruments and samples

2.1 Test instrument

FTIR prestige-21 type Fourier transform infrared spectrometer (Japan, Shimadzu International Trade Shanghai Co., Ltd.), XT220A electronic balance (Switzerland, Precisa), type 800 centrifuge, SK2200HP ultrasonic extraction instrument (Shanghai branch), Rotary screw pulverizer, plate dryer and plate mold, agate mortar, infrared drying lamp, dhg-9076a thermostatic air drying box, etc.

2.2 Reagent

Spectrally pure potassium bromide

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2.3 Sample

Green pepper and safflower peppers in Ludian County of Zhaotong and Qujing in Yunnan were used as experimental materials, their infrared absorption spectra were measured by Fourier transform infrared spectrometer.

3. Sample processing and determination

3.1 Sample pretreatment

The different parts of the Chinese prickly ash by 60 ℃ drying 6 h, separate the seeds from shell and crushing, respectively.

3.2 Sample determination

The sample powder and the potassium bromide are placed in a mortar at a ratio of 1:150 (mg: mg), mixed and ground, and compressed, the infrared spectrum was measured with pure potassium bromide as blank. The scanning range was 4000 ~ 400 cm-1, the resolution was 4cm-1, and the scanning number was 10 times.

4. Spectrum processing

The infrared spectra were superimposed and labeled to observe the differences of seeds and shells in the same place and the differences of the same parts in different places. At the same time, through the experimental data to draw two-dimensional graphics, three-dimensional graphics for analysis.

5. Results and discussion

The infrared spectra of different pepper seeds and shells in different places were compared, and their infrared characteristic absorption peaks were shown in table 1.

Table 1 Characteristic absorption peaks of different species of pepper in different places

Experimental sample	Characteristic absorption peak [cm-1]
Qujing green shell	667.37 1111.00 1161.15 1442.75 1625.99 1666.50 1743.65 2358.94 2854.65 2926.01 3311.78
Qujing green seed	669.30 721.38 1163.08 1465.90 1745.58 2362.80 2854.65 2926.01 3448.72 667.37 1111 1161.15 1442.75 1625.99 1666.5 1743.65 2358.94 2926.01
Qujing red shell	426.27 721.38 1163.08 1458.18 1558.48 1745.58 2360.87 2852.72 2924.09 3008.95
Qujing red seed	669.30 767.67 831.32 1031.92 1051.20 1107.14 1159.22 1255.66 1369.46 1442.75 1560.41 1602.85 1670.35 1734.01 2927.94
Zhaotong green shell	721.38 1163.08 1458.18 1560.41 1745.58 2358.94 2852.72 2922.16 3008.95
Zhaotong green seed	767.67 833.25 1051.20 1105.21 1159.22 1261.45 1328.95 1367.53 1440.83 1544.98 1606.70 1670.35 1734.01 2924.09 2968.45 3280.92 3493.09
Zhaotong red shell	
Zhaotong Red Seed	721.38 1165.00 1458.18 1560.41 1743.65 2360.87 2852.72 2922.16 3008.95

It can be seen from Table 1 that the infrared absorption spectra of the selected 8 pepper samples in the range of 4000-400 cm-1 are basically the same, and the C-H stretching vibration peak with unsaturated carbon at 3008 cm-1 is shown in 2926. C-H stretching vibration peak of saturated carbon at cm-1 and 2852 cm-1,there is a stretching vibration peak of C = O at 1745 cm-1, a bending vibration peak of methylene at 1458 cm-1, a stretching vibration peak of c-o in triglyceride at 1163 cm-1 and a stretching vibration peak of carbon and carbon triple bonds at 2360 cm-1. [4] - [7]

Although their infrared characteristic absorption spectra are basically the same, there are obvious differences between them in the range of 1745 cm-1-1458 cm-1. For example, the vibration peak of the carbon chain skeleton at 721 cm-1, the bending vibration peak of -CH3 at 1373 cm-1 is different. Although there are differences, due to their commonality, the simple use of infrared spectra is not conducive to differentiation. Therefore, the peak height, peak area of correction, and peak area of correction were further used as characteristic peak parameters for discriminant analysis, and the results were compared [6]. The infrared spectra of the eight samples were significantly different at 1745-1458 cm-1. This information is the C=O stretching vibration of the amide of the main component of the pepper and the stretching vibration absorption peak of C=C in the aromatic ring. At 2926 cm-1 and 3448 cm-1, the characteristic absorption was stronger. Therefore, the correlation parameters of absorption peaks at 1458 cm-1, 1745 cm-1, 2926 cm-1 and 3448 cm-1 are selected as the original data for pattern recognition [8].

According to the infrared spectrum data of different places of pepper green shell, red pepper shell, red pepper seed, and green pepper seed, the ratio of peak area (A) of 2926 cm-1 to 3448 cm-1 wavenumber A 2926 cm-1 /A3448 cm- 1 is the abscissa, the ratio of the peak area (A) of 1458 cm-1 to 1745 cm-1 wavenumber (A) is A1458 cm-1 / A1745 cm-1 is the ordinate, and the two-dimensional map is drawn by Origin 8.0 chemical software.

Table 2 Ratio of characteristic absorption peaks of pepper seeds and shell infrared absorption spectra

Wave number [cm-1]	Qujing				Zhaotong			
	Green shell	Green seed	Red shell	Red seed	Green shell	Green seed	Red shell	Red seed
A2926/A3448	0.9935	1.2239	1.6701	2.7470	2.9752	7.3213	1.5401	4.1246
A1458/A1745	0.9962	0.8203	1.0064	0.7659	1.1567	0.8367	1.1O15	0.8487

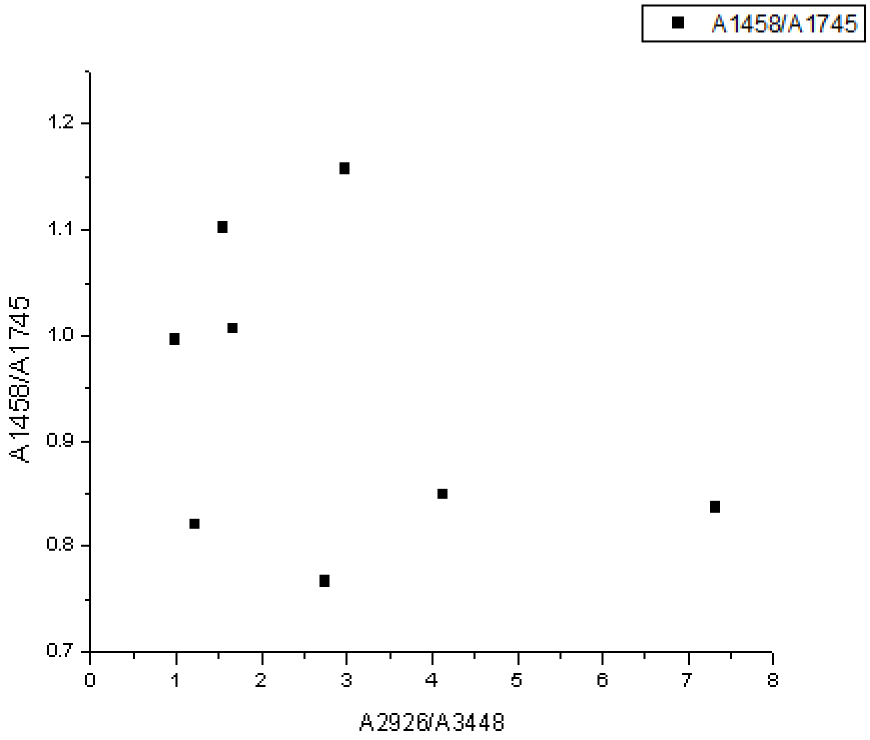


FIG. 1 two-dimensional distribution of different types of pepper (seed and shell) in different places

It can be clearly seen from Figure 1 that the distribution of the eight solid samples is different, so this method can be well used to identify the differences between the seeds and shells in the same place and the seeds in different places and in different places.

In order to be more intuitive and convenient to distinguish the pepper, the ratio of the characteristic absorption peak of 2926 cm-1 to the peak area of 3448 cm-1 (A) of 8 samples was taken as the X-axis, and the ratio of the peak area (A) of 1458 cm-1 to 1745 cm-1 was taken as the Y-axis, and The wave number of the strongest peak of 1745 cm-1 in the characteristic region of the main component of pepper is taken as the Z axis, and a three-dimensional map such as 2 and 3 is drawn.

Table 3 Ratio of the absorption peaks and peaks in the infrared absorption characteristics of each pepper

Wave numbercm-1	Qujing				Zhaotong			
	Green shell	Green seed	Red shell	Red seed	Green shell	Green seed	Red shell	Red seed
A2926/A3448	0.9935	1.2239	1.6701	2.7470	2.9752	7.3213	1.5401	4.1246
A1458/A1745	0.9962	0.8203	1.0064	0.7659	1.1567	0.8367	1.1O15	0.8487
Z	1743	1745	1743	1745	1734	1745	1734	1743

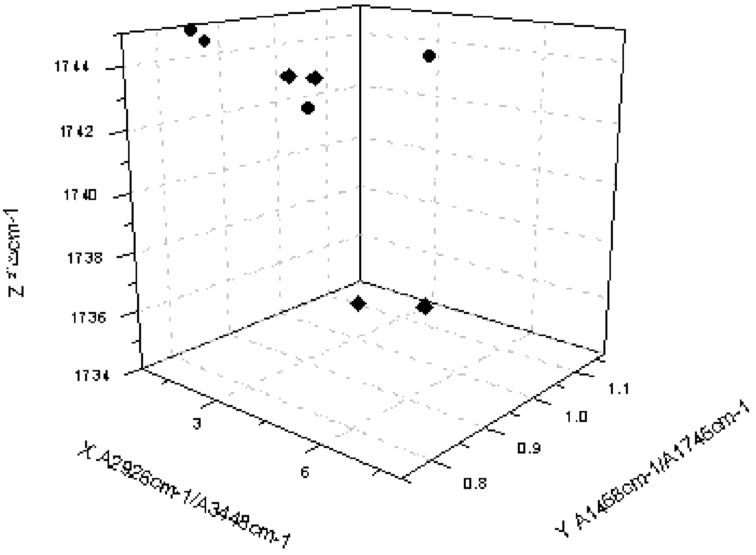
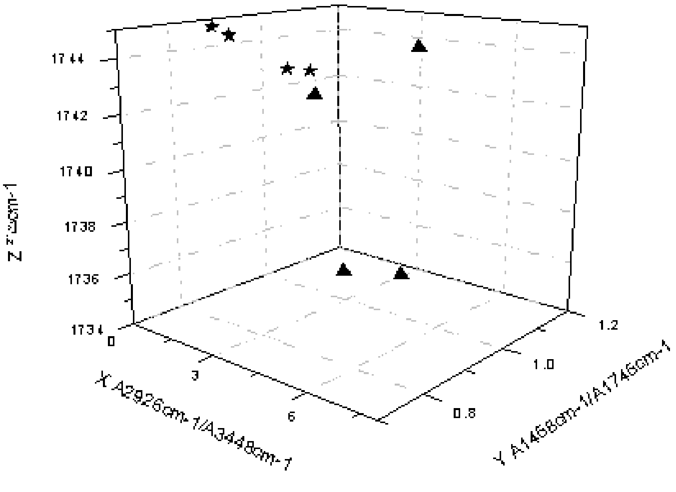


FIG. 2 Analysis of pepper seeds and shells taking peak area ratio and wave number as parameters



★Represent Zhaotong▲Represent Qujing

FIG. 3 Analysis diagram of zhaotong and qujing based on the parameter of peak area ratio and wave number

It can be seen from the three-dimensional distribution map that the distribution of pepper seed and pepper shell is not very strong, but there is a clear distribution difference between peppers in different places.

6. Conclusion

The infrared spectra of pepper seeds and shells were determined by Fourier transform infrared spectroscopy using different places of green and red pepper as raw materials. From the infrared spectrogram, we can see that although there are differences in the infrared spectrogram of pepper in different places, the two-dimensional and three-dimensional Spectrogram Based on the infrared data is difficult to analyze because of the high similarity of the spectrogram. Enhancing the recognition ability of the spectrum provides a new method for the identification of pepper.

The results show that the Fourier transform infrared spectroscopy (ftir) is feasible to distinguish the seeds and shells of pepper in different places.

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