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Analysis of fingerprints features of infrared spectra of various processed products of Rhizoma Coptidis and their different extracts

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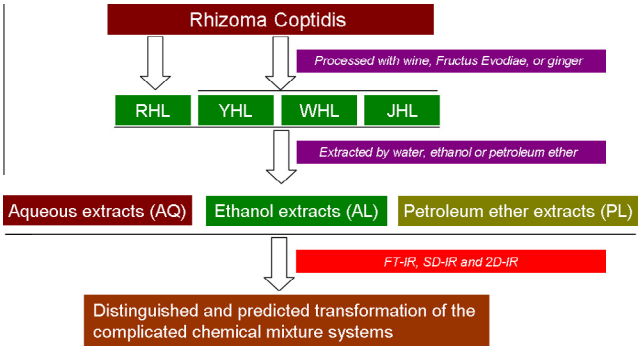
HIGHLIGHTS

- Discriminate Rhizoma Coptidis and its processed products by a multi-step IR method.
- Distinguish extracts of various preparata of Rhizoma Coptidis by FT-IR with 2D-IR.
- Berberine contents were estimated correlation coefficients analysis.

GRAPHICAL ABSTRACT



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ABSTRACT

Fourier transform infrared spectroscopy (FT-IR) associated with second derivative infrared spectroscopy (SD-IR) and two-dimensional correlation infrared spectroscopy (2D-IR) are employed to analyze various processed products and different extracts of Rhizoma Coptidis. There is a shift of the peak of 1641 cm^{-1} of raw Rhizoma Coptidis after processed, which drifts to lower wave number. Peaks at 1508, 1387, 1363, 1332, 1274 and 1234 cm^{-1} barely change in most samples, except an obvious enhancement of these peaks after processed, suggesting that processed Rhizoma Coptidis may have higher content of berberine than raw material, which is corresponding to the results of correlation coefficients analysis. There are some differences in the absorption peaks in the range of 1800–1000 cm^{-1} in the SD-IR spectra, which have better resolution, of different processed products. 2D-IR spectra, which elevate the resolution further, can present more differences among the products in the range of 1300–800 cm^{-1} and 1800–1300 cm^{-1}. Analysis of aqueous, ethanol and petroleum ether extracts of various processed products proves that there are distinctive differences of all auto-peaks in shapes and intensities in all of them. With the advantages of high resolution, high speed and convenience, FT-IR combined with 2D-IR can quickly and precisely distinguish various processed products of Rhizoma Coptidis and can be applied to predict the tendency of transformation of the complicated chemical mixture systems under heat perturbation.

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Introduction

Rhizoma Coptidis is one of the most wildly used medicinal plants in traditional Chinese medicine (TCM) [1]. Its action is to remove damp-heat, quench fire and counteract toxicity. The processing of TCM with excipients has a long history and the efficacy of treatment can be changed by using a combination of excipient treatments [2,3]. The purposes of processing TCM are briefly summarized to strengthen the effect, eliminate or reduce the toxicity, facilitate the preparation and storage of drugs [4]. During processing, secondary plant metabolites are transformed, thus helping to increase the potency and reduce the toxicity, and altering their effects. It is also used for preserving active constituents, facilitating administration, improving flavor and increasing purity of TCM [5]. In China, the processing methods for crude TCM have been practiced since the Tang Dynasty and well-documented in the Chinese Pharmacopoeia [6]. There are three processing methods of Rhizoma Coptidis, including processed with wine (WHL), ginger (JHL), or Fructus Evodiae (YHL) in the Chinese Pharmacopoeia [1]. The action of WHL is to remove fire from the upper part of the body, JHL is to remove fire from the stomach, regulate the stomach function and relieve vomiting, and YHL is to soothe the liver, regulate the stomach function and relive vomiting [1]. Various processed products have different actions, which indicates that complicated compositions have changed after processing.

Presently, HPLC, LC-MS/MS, ^{1}H NMR and GC–MS are often employed [7–10] for various processed products. However, it is complicated to prepare samples for such analysis, and limited

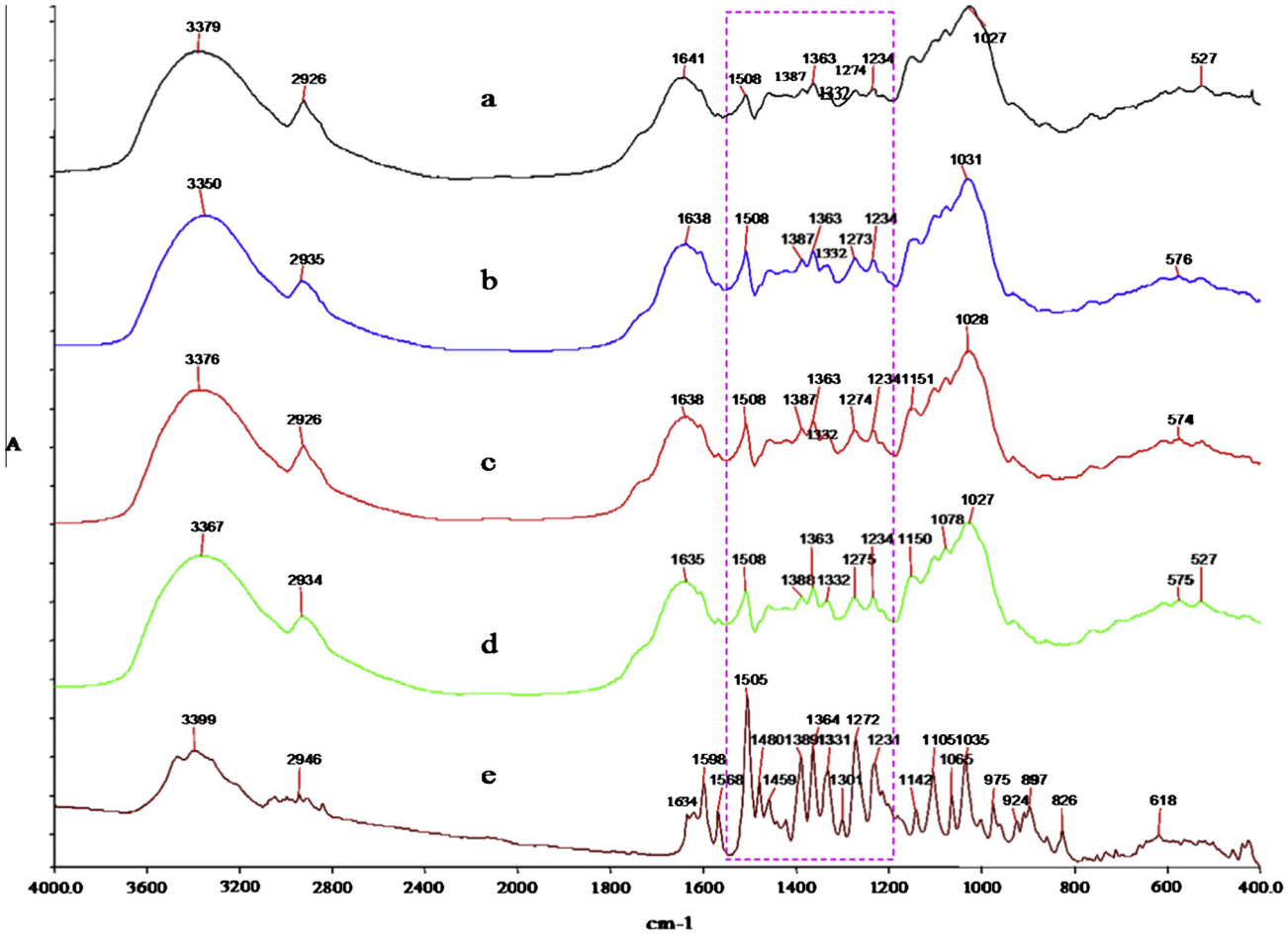

Fig. 1. FT-IR spectra in the range of 4000–400 cm^{-1}: (a) RHL; (b) YHL; (c) WHL; (d) JHL and (e) Berberine.

Table 1
Comparison of assignment of main peaks of four kinds of Rhizoma Coptidis. (See below-mentioned reference for further information.)

Compositions	Band (cm^{-1})	Vibration modes	Main attribution	Raw material			
				RHL	YHL	WHL	JHL
Berberine	1634	ν C=C	Aromatic ring or Heterocyclic ring	1641	1638	1638	1635
	1505	ν C=C	Aromatic ring	1508	1508	1508	1508
	1389	δ NC—H		1387	1387	1387	1388
	1364			1363	1363	1363	1363
	1331			1332	1332	1332	1332
	1272	ν C—O—C	Aromatic fatty ether	1274	1273	1274	1275
	1231			1234	1234	1234	1234
	1035			1027	1031	1028	1027