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Noncontact discrimination of animal and human blood with vacuum blood vessel and factors affect the discrimination

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Discrimination of human and nonhuman blood is crucial for import-export ports and inspection and quarantine departments. Current methods are usually destructive, complicated and time-consuming. We had previously demonstrated that visible diffuse reflectance spectroscopy combining PLS-DA method can successfully realize human blood discrimination. In that research, the spectra were measured with the fiber probe under the surface of blood samples. However, open sampling may pollute the blood samples. Virulence factors in blood samples can also endanger inspectors. In this paper, we explored the classification effect with the blood samples measured in the original containers—vacuum blood vessel. Furthermore, we studied the impact of different conditions of blood samples, such as coagulation and hemolysis, on the prediction ability of the discrimination model. The calibration model built with blood samples in different conditions displayed a satisfactory prediction result. This research demonstrated that visible and near-infrared diffuse reflectance spectroscopy method was potential for noncontact discrimination of human blood.

Key words: non-contact; blood discrimination; visible and near-infrared spectroscopy; diffuse reflectance spectroscopy

1. Introduction

The inspection and discrimination of human blood are significantly important for import-export ports and inspection and quarantine departments [1]. Whole blood products export was tightly controlled, and human blood export was even forbidden by Chinese national law. With the development of individualized medical treatment, genetic diversity were paid great attention by medical institutions. Human blood products carry national genetic information, so the escape may endanger the healthy development of Chinese national bio pharmaceutical industry. The export and loss of human blood products may also make Chinese national security in danger, since biological weapon may be made for terrorist activities. Current methods for the identification of human whole blood samples are mostly destructive, complicated and time-consuming, such as DNA tests [2-3] and other analytical methods [4-5]. Some commercially available kits recognize and bind to human hemoglobin using antihuman hemoglobin antibodies [6]. High performance liquid chromatography (HPLC) [7] and mass spectrometry (MS) [8] are both rising analytical techniques applying to discriminating blood species. Because of their destructive characteristics, these methods were not the best choice for inspection and quarantine departments. Raman Spectroscopy method was also demonstrated to be efficient for identification of blood species [9-12]. Recently, attenuated total reflection Fourier transform infrared spectroscopy method was proved to be effective for the species identification of human and animal blood samples [13]. However, Raman spectroscopy method and the above mentioned method are useful for bloodstain in forensic cases, and have not been proved to be applicable for liquid whole blood tests. Near-Infrared diffuse transmitted spectra have been proved to be potential to identify the species of origin of blood samples [1, 14]. Visible diffuse reflectance spectroscopy combined with PLS-DA method has been proved to be effective for discriminating human blood and nonhuman blood [15-16]. However, these measurement was performed with open sampling means, which may pollute blood samples. Moreover, Virulence factors in blood samples can also endanger inspectors. In

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