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Comparison of hair from rectum cancer patients and from healthy persons by Raman microspectroscopy and imaging ☆

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HIGHLIGHTS

- Raman spectra of hair from cancer patients show some abnormality.
- Raman imaging provides more details by identifying patient hair micro-structures.
- Raman microspectroscopy and imaging of hair may be useful for cancer diagnosis.

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ABSTRACT

In this work, Raman microspectroscopy and imaging was employed to analyze cancer patients' hair tissue. The comparison between the hair from rectum cancer patients and the hair from healthy people reveals some remarkable differences, such as for the rectum cancer patients, there are more lipids but less content of α-helix proteins in the hair medulla section. Though more statistic data are required to establish universary rules for practical and accurate diagnosis, this work based on case study demonstrates the possibility of applying Raman microspectroscopy to reveal abnormality in non-cancer tissues such as hair in order to predict and diagnose cancers.

1. Introduction

Raman spectroscopy is a powerful tool which has been widely applied in biological and biomedical areas because it can provide characteristic chemical and structural informations of measured bio-samples, and it can be utilized to analyze bio-samples in a convenient and non-invasive fashion [1]. Especially, with the development of Raman microspectroscopy and imaging technology, nowadays it allows to analyze a bio-sample with both chemical composition information and high spatial resolution. Recently, with the encouraging progress in the innovative technology such as optical biopsy, targeted techniques and surface-enhanced Raman spectroscopy (SERS), a new trend emerges as to apply Raman spectroscopy and imaging in medical diagnosis of diseases [2–4]. For example, Raman spectroscopy has been applied for diagnosis diseases on the molecular and cellular levels such as breast cancer [3–6], bladder cancer [7,8], prostate cancer [9,10] and cervical cancer [11].

Cancer is the enemy of human health and millions of people die of cancers each year. Currently, accurate cancer diagnosis mostly depends on biopsy or histopathological examination which requires to retrieve cancer tissue samples from patients' bodies. The sampling for biopsy is inconvenient and normally causes great pains of patients. According to Chinese traditional medicine, however, human tissues such as hair and finger nails can reveal people's health conditions. In this sense, hair and finger nails may also serve as the objects for disease prediction or diagnosis. Actually, some studies have already demonstrated the usefulness of spectroscopy and imaging methods in some biomedical researches and applications based on the analysis of the chemical composition changes in personal hair [12–14]. Inspired by these studies, this work attempted to identify certain cancer diseases by analyzing some cancer patients' hair based on the information obtained from Raman microspectroscopy and imaging. The comparison between

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the hair from the cancer patients and the hair from normal people reveals some remarkable differences in the distribution of lipid and protein in the cross-section of hair, suggesting that Raman micro-spectroscopy and imaging of non-cancer tissues may also provide an alternative quick and convenient tool to diagnosis of cancer diseases.

2. Experimental

2.1. Sample preparation

The patient hair was taken from four rectal cancer patients who were hospitalized in the First Affiliated Hospital of Anhui Medical

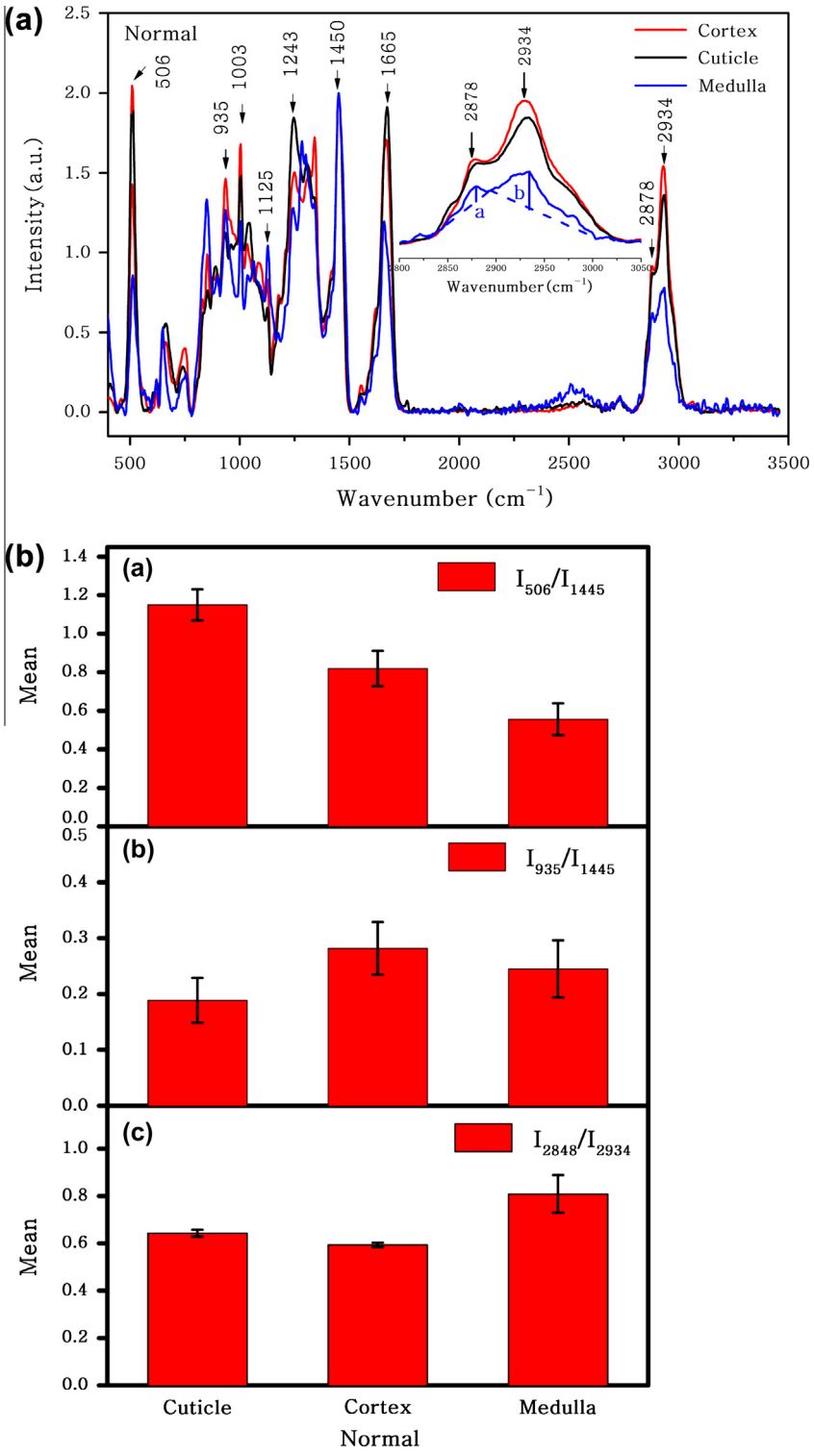

Fig. 1. (a) Raman spectra from the three sections which are normalized at 1450 cm^{-1}. In the hair cross-section, six different locations of each section (medulla, cortex and cuticle) were chosen randomly for collecting spectra. (b) Comparison of the differences for the intensity ratios for I(506 cm^{-1})/I(1445 cm^{-1}), I(935 cm^{-1})/I(1445 cm^{-1}), and I(2848 cm^{-1})/I(2934 cm^{-1}) among three different parts of the normal hair.