

MASTER'S THESIS

Impact of Sulfur Fumigation on the Chemistry of Chinese Medicine: Case Studies on *Dioscoreae Rhizoma* and *Morindae Officinalis Radix*

CHAN, Yui Man

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ABSTRACT

Sulfur fumigation is a common practice used by herbal farmers and wholesalers in the post-harvest treatment of Chinese medicine for preservation. Sulfur dioxide produced during sulfur fumigation can react with chemical components in Chinese medicine and impact on its chemical profile. Such alteration may affect the efficacy and safety of Chinese medicine. Therefore, investigation on the chemical alteration induced by sulfur fumigation is fundamental and crucial. The aim of this study is to investigate the impact of sulfur fumigation on the chemistry of *Dioscoreae Rhizoma* (DR) and *Morindae Officinalis Radix* (MOR), two commonly used Chinese medicine in Hong Kong.

Sulfur fumigation serves as a common treatment for processing DR. Previous study reported that biological and chemical properties of DR can be affected by sulfur fumigation. Notably, consumption of sulfur-fumigated DR can be related to nephrotoxicity and hepatotoxicity. However, it remains largely unknown about the exact impact of sulfur fumigation on the chemical profile of DR and the underlying mechanisms. Therefore, the chemical impact of sulfur fumigation on DR was investigated. In this study, metabolomics strategy was employed through ultra-performance liquid chromatography-quadrupole time-of-flight mass spectrometry (UPLC-QTOF-MS/MS) to study the chemical discrepancy of small metabolites in sulfur-fumigated DR (S-DR) and non-fumigated DR (NS-DR), followed by characterization and comparison of polysaccharides in NS-DR and S-DR through spectroscopy and chromatographic approaches. The results showed that the chemical profile of small metabolites and polysaccharides in DR were altered by sulfur fumigation qualitatively and quantitatively. Chemical alteration caused by sulfur fumigation can be related to various chemical transformation mechanisms (*e.g.*, hydrolysis and sulfonation) and histological change. This study underlays scientific evidence for further investigation on the pharmacological impacts of sulfur fumigation on DR.

Sulfur fumigation can be employed during processing of MOR for better storage. However, research on sulfur fumigation of MOR is still lacking. Whether and how does the chemical profile of MOR influenced by sulfur fumigation remains to be explored. Thus, the impact of sulfur fumigation on the chemistry of

MOR were studied through metabolomics and saccharides analysis. In this study, UPLC-QTOF-MS/MS analysis was performed to analyze and compare the chemical profiles of small metabolites in sulfur-fumigated MOR (S-MOR) and non-fumigated MOR (NS-MOR). Chromatographic approaches, including high performance gel permeation chromatography (HPGPC) and high-performance liquid chromatography coupled with charged aerosol detector (HPLC-CAD), were then employed for the analysis of saccharides in NS-MOR and S-MOR. The results indicated that small metabolites in MOR were affected by sulfur fumigation, particularly iridoid glycosides and caffeoylquinic acids. Also, sulfur-derivatives were found in S-MOR. Besides, sulfur fumigation induced chemical alteration on the saccharide components of MOR. For instance, the peak intensities of oligosaccharides reduced, while the peak intensities of monosaccharides increased. Multifaced chemical reactions (*e.g.*, hydrolysis, sulfonation, sulfation) can be involved in the chemical variations between NS-MOR and S-MOR. This study provides chemical foundation for investigation on efficacy of S-MOR in the future.

To conclude, metabolomics and saccharides analysis were successfully performed for the investigation of the impact of sulfur fumigation on the chemistry of DR and MOR. This study demonstrated that the chemical profile of small metabolites and saccharides in DR and MOR were altered by sulfur fumigation. The research outcome served as an important reference for future research on other sulfur-fumigated Chinese medicine.