

## 学 位 論 文 要 旨

氏 名

SITI IRMA RAHMAWATI

題 目

Extraction of Indonesian Mistletoe Using Hot Compressed Solvent Extraction and Properties of the Resulted Extracts

(インドネシア産ヤドリギ中の機能性物質の高温高压溶媒抽出と抽出物の機能性に関する研究)

Mistletoes are traditional medicinal plant in Indonesia that can be used to treat cancer. Research interests on bioactivity of mistletoes have been arisen from pharmacologists since mistletoes had diverse compounds such as alkaloids, phenylpropanoids, triterpenes, polysaccharides, peptides, lectins, flavonoids and phytosterols. One of the famous mistletoe in Indonesia is tea mistletoe (*Scurrulla atropurpurea*) or *benalu teh* (Indonesian).

In general, mistletoes for medicinal intake are subjected to a traditional extraction by decoction with water. However, the method could suffer from some issues due to low yield and serious chemical degradation by heat during a long extraction time. In order to overcome these issues, we used hot compressed solvent extraction (HCSE). The HCSE is an extraction technique under elevated temperatures by which a rapid (<60 min) extraction at high temperatures to avoid any degradation of bioactive compounds. We also applied pressure to the extraction, higher than solvent vapor pressure to keep the solvent in the liquid phase even on high temperature. Through this method of extraction, we hoped to obtain a better result of the extraction than the traditional extraction method.

Tea mistletoe was extracted using traditional and batch reactor with different solvents (water, 30%, 50%, 70% and 99% ethanol) at different temperatures (40<sup>0</sup>–180<sup>0</sup> C) and for different time periods (10-20 minutes) under additional pressure 0.2 MPa. The resulted extracts were analyzed by antioxidant activity (ABTS) and total phenolic content. Thereafter, identification and quantification of flavonols as bioactive compounds from tea mistletoe were determined by HPLC. The analyses results suggested that the best extraction condition was 30% ethanol solvent with temperature 100<sup>0</sup> C for 10 minutes, with the detected flavonoid predominantly rutin. We considered that suitable water and ethanol mixture, boiled temperature, shorter time of extraction, and also the addition of pressure could extract active compound from mistletoe.

We also optimized the extraction extract content, by enhance the solubility of the bioactive compounds that are poorly soluble in aqueous solutions using hydroxypropyl- $\beta$ -cyclodextrin ( $\beta$ -CD) into solvent of extraction. This study investigated how the addition of  $\beta$ -CD to the extraction influenced the yield of the extract, the antioxidant activities, the total phenolic content and the cytotoxicity of the extracts on colon cancer cells. The assays showed significant differences for all the treatments, which demonstrate that the addition of  $\beta$ -CD influenced the extracted bioactive compounds. However, this extract showed the cytotoxic effects in colon cancer cells and normal cells. So we suggested that the addition of  $\beta$ -CD is not necessary.

The next studies were the application of HCSE optimum method to others mistletoes such as *Scurrula*, *Dendrophthoe* and *Macrosolen*, which are typical medicinal plants in Indonesia. As the result of experiments regarding antioxidant activity by ABTS method, along with polyphenolic profiles in each extract, an extract from *S. oortiana* showed a high antioxidant activity as well as high content of phenolic compounds among HCSE-aided mistletoes extracts. Candidates responsible for the effect were quercetin 4'-*O*- $\beta$ -glucopyranoside and gallic acid; other phenolic compounds such as catechin, epicatechin, rutin, and quercetin partly contributed to the antioxidant effect of mistletoe extracts by HCSE method.