

## 学位論文要旨 Dissertation Abstract

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学位論文題目 : **Investigation of Thai Medicinal Plants for Their Allelopathic Potential and Bioactive Compounds**  
Title of Dissertation (タイの薬用植物におけるアレロパシー活性と生理活性物質に関する研究)

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Dissertation Abstract

Allelopathy is a mechanism mediated by the release of secondary metabolites “allelopathic compounds” from a donor plant into the surrounding environment. The compounds have influence on the growth and development of receiver plants in either inhibitory or stimulatory effects. However, the inhibitory effects, such as the inhibition of seed germination and seedling growth of other plants, receive much attention because it is useful in agricultural system as biological control of weeds. The success of using allelopathic plants and/or allelopathic compounds to control weeds while maintaining high crop yields have been observed, and these are in demand to alleviate negative effects of using herbicides in such a long time. Therefore, allelopathic plants and/or allelopathic compounds are promising candidates for weed control in sustainable agriculture.

This research was performed to study the allelopathic activity of medicinal plants from Thailand. The medicinal plants used in this study are *Cymbopogon nardus*, *Piper retrofractum*, and *Acmella oleracea*. The aqueous methanol extracts of the root of *C. nardus*, the fruit of *P. retrofractum* and the whole plant of *A. oleracea* showed the activity against seedling growth of monocotyledons (barnyard grass, Italian ryegrass, jungle rice, timothy) and dicotyledons (alfalfa, cress, lettuce, rapeseed) in concentration- and test species-dependent. Comparison the concentration required for 50% growth inhibition ( $IC_{50}$  values) of all the extracts on the seedling growth cress, lettuce, barnyard grass and Italian ryegrass, it was found that the fruit extracts of *P. retrofractum* had stronger phytotoxic activity than the root extracts of *C. nardus* and the whole plant extracts of *A. oleracea*, with the values in the range between 0.3–13.8, 4–19, and 0.4–126 mg dry weight equivalent extract/mL, respectively. The phytotoxic effect of these medicinal plants implies that the plants may have allelopathic property and may contain compounds responsible for the activity.

Therefore, compounds with the growth inhibitory activity were isolated using bioassay-guided fractionations and identified using HRESIMS,  $^1\text{H}$  NMR, and  $^{13}\text{C}$  NMR. Two active compounds were isolated from the root extracts of *C. nardus* and identified as myrislignan and *N*-octanoyl tyramine. Seven active compounds were isolated from the fruit extracts of *P. retrofractum* and identified as 3-phenylpropanoic acid, (2*E*,4*E*)-methyl piperate, (2*E*,4*Z*)-methyl piperate, piperlonguminine, dihydropiperine, isochavicine, and piperine. Two active compounds were isolated from the whole plant extracts of *A. oleracea* and identified as undeca-2*E*,4*E*-dien-8,10-diyonic acid isobutylamide and nona-2*Z*-en-6,8-diyonic acid 2-phenylethylamide.

*N*-Octanoyl tyramine and the seven compounds from *P. retrofractum* had the activity to delay seed germination of cress and barnyard grass by decreasing total seed germination and germination index, and extending time required for 50% germination, at a concentration greater than 1000  $\mu\text{M}$ .

Comparison the  $\text{IC}_{50}$  values of all the isolated compounds on the seedling growth of cress, it was found that isochavicine had the strongest activity with the values of 11–18  $\mu\text{M}$ , and followed by piperlonguminine, piperine and dihydropiperine with the values of 10–25, 23–35 and 79–116  $\mu\text{M}$ , respectively, and with the values between 104–2200  $\mu\text{M}$  for the other compounds. For the  $\text{IC}_{50}$  values of barnyard grass, it was found that piperine had the strongest activity with the values of 37–238  $\mu\text{M}$ , and followed by dihydropiperine, isochavicine and (2*E*,4*E*)-methyl piperate with the values of 131–487, 153–758 and 379–659  $\mu\text{M}$ , respectively, and with the values between 47–22403  $\mu\text{M}$  for the other compounds.

The present study showed that *C. nardus*, *P. retrofractum* and *A. oleracea* had the activity against seedling growth of monocotyledons and dicotyledons, which may contribute to their allelopathic potential. Eleven compounds isolated from these plant extracts had the activity against seed germination and/or seedling growth of cress and barnyard grass. These compounds may be the main growth inhibitors involved in the allelopathic activity of *C. nardus*, *P. retrofractum* and *A. oleracea*. To the best of our knowledge, this study is the first to report the allelopathic activity of these medicinal plants and their compounds responsible for the activity. Therefore, these Thai medicinal plants have the possibility to use their plant residues, plant extracts or the bioactive compounds as biological control for weed management.