

学位論文要旨 Dissertation Abstract

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学位論文題目 : Allelopathy of Myanmar Medicinal Plants and Identification
Title of Dissertation of their Allelopathic Substances for the Development of
Bioherbicides
(バイオ除草剤開発を目的としたミャンマーに生育する薬用
植物のアレロパシーおよびそれらのアレロパシー物質の同
定)

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Allelopathy is a natural mechanism in which plants release secondary metabolites (allelochemicals) that cause an inhibitory or stimulatory effect on another plant. When allelochemicals are expelled into the neighbouring environment, which can affect the growth and development of adjacent plants by influencing different physiological functions such as membrane permeability and cell extension and division. Hence, the allelopathic potential of plants and allelochemicals has been suggested as an alternative tool for weed management. Notably, medicinal plants are a rich source of secondary metabolites, and several medicinal plant species have been investigated for their allelopathic substances. However, the allelopathy and allelopathic substances of numerous medicinal plant species remain to be explored. Therefore, this research has focused on investigating the potential allelopathic plants and isolating potent allelopathic substances from Myanmar medicinal plants.

Five medicinal plant species, namely, *Tradescantia spathacea* Sw., *Spondias pinnata* (L.f.) Kurz, *Clerodendrum indicum* (L.) Kuntze, *Dregea volubilis* (L.f.) Benth. ex Hook.f., and *Oldenlandia corymbosa* L. were used in this study. The aqueous methanol extracts of the *T. spathacea*, *S. pinnata*, *C. indicum*, *D. volubilis*, and *O. corymbosa* showed significant inhibitory effects on the seedling growth of alfalfa, cress, lettuce, barnyard grass, Italian ryegrass, and timothy. However, the effectiveness of the inhibition varied with each extract concentration. The I_{50} values (concentration required for 50% inhibition) of five medicinal plant species for shoot and root growth of all test plants differed. Thus, concentration- and species-specific growth inhibitory effects of *T. spathacea*, *S. pinnata*, *C. indicum*, *D. volubilis*, and *O. corymbosa* on the test plants suggest that these medicinal plants have

allelopathic potential and, therefore, might possess the plant growth inhibitory substances with allelopathic properties.

Aqueous methanol extracts of each medicinal plant were purified through a series of chromatography and bioassay-guided fractionations resulted in the isolation of seven inhibitory substances; *p*-coumaric acid from the extracts of *C. indicum*, dehydrovomifoliol, loliolide, 3-hydroxy- α -ionone, and 5-hydroxy-3,4-dimethyl-5-pentylfuran-2(5H)-one from the extracts of *D. volubilis*, and hedyotiscone A and B from the extracts of *O. corymbosa*. In addition, two unknown inhibitory substances were isolated from *T. spathacea* and *S. pinnata* extracts, which are required to identify and may have potential in weed control in the natural-based system.

p-Coumaric acid isolated from the extracts of *C. indicum* significantly suppressed the growth of lettuce and timothy seedlings at concentrations greater than 0.3 and 1 mM, respectively. In addition, the concentrations of *p*-coumaric acid required for 50% inhibition (I_{50}) of the shoots and roots of lettuce and timothy were 0.652 and 0.171 mM, and 0.810 and 0.673 mM, respectively. These results indicate that *p*-coumaric acid may partly contribute to the allelopathic potential of *C. indicum*.

Loliolide, dehydrovomifoliol, 3-hydroxy- α -ionone, 5-hydroxy-3,4-dimethyl-5-pentylfuran-2(5H)-one were isolated from the extracts of *D. volubilis*, and their biological activities were evaluated against cress. Four identified substances isolated from *D. volubilis* extracts exhibited significant inhibitory effects on the cress shoots and roots with the I_{50} values of 0.022 and 0.029 mM, for loliolide, 3.240 and 3.790 mM, dehydrovomifoliol, 0.261 and 0.132 mM, for 3-hydroxy- α -ionone, and 0.422 to 0.183 mM, for 5-hydroxy-3,4-dimethyl-5-pentylfuran-2(5H)-one, respectively. These results indicated that these four substances might be responsible for the allelopathy of *D. volubilis*.

Hedyotiscone A and B were isolated from the extracts of *O. corymbosa*. Hedyotiscone A and B significantly inhibited the seedling growth of cress at concentrations greater than 0.3 mM. The I_{50} values of hedyotiscone A and B for the cress seedlings ranged from 0.023 to 0.131 mM and 0.167 to 0.810 mM, respectively. The inhibitory activity against the seedling growth of cress indicates that hedyotiscone A and B may cause the allelopathic effects in *O. corymbosa*.

In this research, five medicinal plant species have shown significant allelopathic potential on test plants' shoot and root growth, indicating those plants may contain inhibitory substances. In addition, seven potent allelopathic substances were isolated and identified from *C. indicum*, *D. volubilis*, and *O. corymbosa*. Those substances also displayed allelopathic

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effects on the growth of test plant seedlings. Moreover, two unknown substances isolated from *T.spathacea* and *S.pinnata* extracts exhibited growth-inhibitory effects on cress seedlings, which suggests that these unknown substances may partly provoke the allelopathic properties of *T.spathacea* and *S.pinnata*. Therefore, the plant residue of these medicinal plants, their plant extracts, and /or their growth inhibitory substances may be potential candidates for developing bioherbicides.