

学位論文要旨 Dissertation Abstract

氏名 : A. K. M. MOMINUL ISLAM
Name

学位論文題目 : ALLELOPATHY OF FIVE LAMIACEAE MEDICINAL PLANT
Title of Dissertation SPECIES (5種のシソ科薬用植物のアレロパシー)

学位論文要旨 :
Dissertation Abstract

Plants belong to Lamiaceae family attracted the attention of many researchers in pharmacological interest because of their toxic potential and myriad of medicinal properties. But information about the allelopathy of the family is inadequate. Therefore, this research has been conducted to explore the allelopathic potential of five Lamiaceae medicinal plant species: *Leucas aspera*, *Hyptis suaveolens*, *Mentha sylvestris*, *Leonurus sibiricus* and *Ocimum tenuiflorum*, and further isolation and characterization of active allelopathic substances from the plant that possess strong allelopathic properties.

Those plants were collected from Bangladesh and extracted with 70% (v/v) aqueous methanol. Their biological activities were determined against germination of cress (*Lepidum sativum*) and barnyard grass (*Echinochloa crus-galli*), and the growth of cress, lettuce (*Lactuca sativa*), alfalfa (*Medicago sativa*), rapeseed (*Brassica napus*), timothy (*Phleum pratense*), crabgrass (*Digitaria sanguinalis*), barnyard grass and Italian ryegrass (*Lolium multiflorum*). Additionally, effects of *O. tenuiflorum* extract on several germination indices of all but rapeseed and crabgrass were measured.

A significant delay and/or inhibition of germination was observed on both cress and barnyard grass by those plant extracts at 100 mg dry weight equivalent extract mL⁻¹ except *L. sibiricus* on barnyard grass. Moreover, *O. tenuiflorum* inhibited all the measured germination indices at concentrations greater than 30 mg dry weight equivalent extract mL⁻¹ with very few exceptions.

The *L. aspera* and *H. suaveolens* plant extracts inhibited the hypocotyl/coleoptile and root growth of all test species at or greater than 10 mg dry weight equivalent extract mL⁻¹ except Italian ryegrass and alfalfa. In contrast, *M. sylvestris*, *L. sibiricus* and *O. tenuiflorum* extracts inhibited all test species at 100 mg dry weight equivalent extract mL⁻¹. The concentrations lower than the thresholds of inhibition have tendency to stimulate the hypocotyl/coleoptile and root growth. The inhibitory effects of all extracts were concentration and test species dependent. The total average inhibitions on the hypocotyl/coleoptile of all test species by *L. aspera*, *H. suaveolens*, *M. sylvestris*,

L. sibiricus and *O. tenuiflorum* were 46, 39, 15, 20 and 17%, respectively, whereas that of the root growth was 67, 53, 42, 32 and 30%, respectively. The seedling growth of the test species was more sensitive than seed germination. The inhibitory potential of the plant extracts were in the order of *L. aspera* > *H. suaveolens* > *M. sylvestris* > *L. sibiricus* > *O. tenuiflorum*. As *L. aspera* and *H. suaveolens* had higher allelopathic potential than others, further isolation and identification of allelopathic substances were continued from their extracts. Both plant extracts were then purified by several chromatographic runs through bioassay guided fractionation using cress as a test plant. The final purification was achieved by reversed-phase HPLC.

An equilibrium (or inseparable) 3:2 mixture of two novel allelopathic substances were characterized from *L. aspera* as (*rel* 5*S*,6*R*,8*R*,9*R*,10*S*,13*S*,15*S*,16*R*)-6-acetoxy-9,13;15,16-diepoxy-15-hydroxy-16-methoxylabdane (1) and (*rel* 5*S*,6*R*,8*R*,9*R*,10*S*,13*S*,15*R*,16*R*)-6-acetoxy-9,13;15,16-diepoxy-15-hydroxy-16-methoxylabdane (2) by spectroscopic analysis. A mixture of these two compounds inhibits the germination and seedling growth of cress and barnyard grass at concentrations greater than 30 and 3 μ M, respectively. The concentration required for 50% growth inhibition (I_{50}) of cress and barnyard grass by this mixture ranges from 31–180 μ M.

An allelopathic substance was also isolated and identified from *H. suaveolens* extracts as 14 α -hydroxy-13 β -abiet-8-en-18-oic acid (suaveolic acid) by spectroscopic analysis. Suaveolic acid inhibited the hypocotyl/coleoptile growth of cress, lettuce, Italian ryegrass and barnyard grass at concentrations greater than 30 μ M. Root growth of all but lettuce was also inhibited at concentrations greater than 30 μ M. The I_{50} values of suaveolic acid for those test species were ranged from 76–1155 μ M.

These results suggest that the aqueous methanol extracts of all five Lamiaceae medicinal plants have allelopathic potential to suppress the germination and growth of several test plant species. Thus, they may possess allelopathic substances. Two novel allelopathic substances (compounds 1 and 2) from *L. aspera*, and one potent allelopathic substance (suaveolic acid) from *H. suaveolens* have been isolated and the structures are determined. These isolated compounds also showed inhibitory activity to the test species at different inhibition values, indicating their possible involvement in allelopathic activity of the respective plant extracts. Since *L. aspera* and *H. suaveolens* plant extracts showed stronger inhibitory activity than others, their extracts might have potential to use as bio-herbicides, or their isolated substances as templates for new herbicide classes.