

Khellin and Visnagin, Furanochromones from *Ammi visnaga* (L.) Lam., as Potential Bioherbicides

Maria L. Travaini,^{*†[‡]} Gustavo M. Sosa,[‡] Eduardo A. Ceccarelli,[†] Helmut Walter,[‡] Charles L. Cantrell,[§] Nestor J. Carrillo,[†] Franck E. Dayan,[§] Kumudini M. Meepagala,[§] and Stephen O. Duke[§]

[†]Instituto de Biología Molecular y Celular de Rosario (IBR), CONICET, Facultad de Ciencias Bioquímicas y Farmacéuticas, Universidad Nacional de Rosario, Suipacha 531, 2000 Rosario, Argentina.

[‡]AgroField Consulting, Gruenstadter Str.82, 67283 Obrigheim, Obrigheim, Germany.

[‡]Investigaciones Biológicas en Agroquímicos Rosario S.A. (INBIOAR S.A.), Cordoba 1437, 5th floor - office 2, 2000 Rosario, Argentina.

[§]USDA, ARS, Natural Products Utilization Research Unit, P. O. Box 1848, University, MS 38677, United States.

ABSTRACT: Plants constitute a source of novel phytotoxic compounds to be explored in searching for effective and environmentally safe herbicides. From a previous screening of plant extracts for their phytotoxicity, a dichloromethane extract of *Ammi visnaga* (L.) Lam. was selected for further study. Phytotoxicity-guided fractionation of this extract yielded two furanochromones: khellin and visnagin, whose herbicidal activity had not been described before. Khellin and visnagin were phytotoxic to model species lettuce (*Lactuca sativa*) and duckweed (*Lemna paucicostata*), with IC₅₀ values ranging from 110 to 175 µM. These compounds, also inhibited the growth and germination of a diverse group of weeds at 0.5 and 1 mM. These weeds included five grasses [ryegrass (*Lolium multiflorum*), barnyardgrass (*Echinochloa crus-galli*), crabgrass (*Digitaria sanguinalis*), foxtail (*Setaria italica*), and millet (*Panicum* sp.)] and two broadleaf species [morningglory (*Ipomea* sp.) and velvetleaf (*Abutilon theophrasti*)]. During greenhouse studies visnagin was the most active and showed significant contact postemergence herbicidal activity on velvetleaf and crabgrass at 2 kg a. i. ha⁻¹. Moreover, its effect at 4 kg a. i. ha⁻¹ was comparable to the bioherbicide pelargonic acid at the same rate. The mode of action of khellin and visnagin was not a light-dependent process. Both compounds caused membrane destabilization, photosynthetic efficiency reduction, inhibition of cell division and cell death. These results support the potential of visnagin, and possibly khellin, as bioherbicides or lead molecules for the development of new herbicides.