

## Biological activities of some Turkish medicinal plants

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**Abstract:** Turkey has an extraordinarily rich flora and wide knowledge of their indigenous medicinal plants. Medicinal plants constitute an important component of flora and are widely distributed in different floristic regions of Turkey. Historically, plants have supplied the chemistry for over 25 % of prescription drugs used in human medicine(1) and such biologically active plants have also provided leads to natural insecticides(2). Accordingly, we are investigating the potential of Turkish medicinal plants as a resource of new chemistry for public health and plant protection. The biological evaluation of substances from plant sources is highly relevant for the identification of lead compounds which can result in the development of novel and safe medicinal agents. During our extensive studies with Turkish medicinal plants, we have isolated and characterized a large number of natural products. On the other hand, a more systematical approach to the discovery of drugs from these plants has been initiated using bioassay-guided fractionation. At the end of this fractionation of selected plant extracts has resulted in the identification of active compounds representing a wide range of structures, including alkaloids, terpenoids and phenolic compounds(3). Fifty five organosoluble extracts prepared from Turkish medicinal plants were investigated for their biological activities against insects, nematodes, plant pathogens and brine shrimp in addition to their biological activities such as antimalarial, anticholinergic, analgesic and antiplatelet activities.

### INTRODUCTION

Pests of cultivated crops remain the principal limitation to increased agricultural production of food and fiber. Thus, protection of plants from agricultural pests and pathogens remains a primary preoccupation of agricultural scientists. Similarly, insect vectors of diseases such as malaria, filariasis, yellow fever, sleeping sickness and Chagas' disease continue to stifle development efforts in many countries and account for millions of deaths annually. Despite serious environmental concerns over their use and abuse insecticides remain the first line of defense against herbivorous insects, nematodes, plant pathogens and insect vectors of disease. The US Environmental Protection Agency reports use of pesticides in the US alone reached 2.73 billion pounds in 1993, accounting for one-third of world usage. The dimension of this chemical insult to the environment has long range ecological repercussions and adds great impetus to the search for non-toxic, environmentally pacific methods for agricultural and public health pest management. Recent studies reveal that plants possess many subtle defenses that interfere with pest growth, development and behavior and lack any toxicity to higher

animals(4). Historically, plants have supplied the chemistry for over 25 % of prescription drugs used in human medicine(1) and such pharmacologically active plants have also provided leads to natural insecticides(2). Turkey has an extraordinarily rich flora and wide knowledge of their indigenous medicinal plants. Accordingly, we are investigating the potential of Turkish medicinal plants as a resource of new chemistry for plant and public health protection. To investigate the biological actions of Turkish medicinal plant extracts we have developed a variety of screening assays to determine activity against bacterial and fungal pathogens, brine shrimp, insects and nematodes.

## MATERIALS and METHODS

Plants were collected from regions throughout Turkey. Voucher specimens of all accessions were prepared and are maintained in the Herbarium of the Department of Pharmacognosy, Faculty of Pharmacy, Gazi University, Ankara.

Biological evaluations were developed to maximize the information that can be gained from crude plant extracts and which can subsequently be used to follow isolation procedures.

Plant extracts were examined for general toxicity using the brine shrimp, *Artemia salina* following a published procedures(5). Insecticide and insect growth regulating activity against the hemiterpen insect *Oncopeltus fasciatus* was measured following previously described methods(6). Mosquito larvacidal activity was determined with larvae of the Yellow Fever mosquito, *Aedes aegypti*. Nematocidal bioassays were performed by dissolving compounds to be tested in "M-9" buffer (7) and observing the survival of *Caenorhabditis elegans* in the solutions. For the bactericidal assay, *Pseudomonas solanifarum* bacteria was used. Our fungicidal assay using *Cladosporium cucumerinum* is a modification (8) of the method of Klarman and Sanford(9).

## RESULTS

In the evaluation for general toxicity using the brine shrimp, 16 extracts caused complete mortality within 24 hours representing 30 % of the total extracts tested. They are, *Leucosium aestivum* L., *Narcissus tazetta* L., *Pancreatium maritimum* L., *Bongardia chrysogonum* (L.) Spach., *Convolvulus arvensis* L., *Sinapis arvensis* L., *Bryonia alba* L., *Onobrychis armena* Boiss. & Huet., *Fumaria vaillantii* Lam., *Maclura pomifera* L., *Fritillaria imperialis* L., *Fritillaria persica* L., *veratrum album* L., *Viscum album* L. ssp. *album* (Host-*Amygdalus communis* L.), *Daphne oleoides* Schreber., *Biphora radians* Bieb.

In tests against insects 17 extracts possessed significant insecticidal activity against the milkweed bug and 9 were toxic to mosquitos. Although plant extracts toxic to the milkweed bug revealed three prominent families including Amaryllidaceae (4 species), Liliaceae (4 species) and Umbelliferae (3 species) numerous other families were represented such as Campanulaceae, Cruciferae, Cucurbitaceae, Fumariaceae, Papilionaceae and Ranunculaceae. Of the 17 active extracts with insecticidal activity 12 were also represented as toxic to brine shrimp confirming that test as a useful indicator of general toxicity. Four of the extracts, *Sinapis arvensis*, *Veratrum album* (rhizomes only), *Biphora radians* and *Ferula rigidula* showed good cross toxicity to both insect species. However, several extracts showed activity only against the milkweed bug or only against mosquitoes suggesting that some specificity of action may be involved. Resolution of these question can only be solved by isolation and identification of the active compounds and retesting on both species. The utility of selective insecticides is clearly apparent considering the need to control pest species in the presence of beneficial insects such as predatory and parasitic species. It is significant to note that altogether

48 % of the 55 medicinal plant extracts showed insecticidal activity suggesting that insecticidal activity may be an important defensive priority for pharmacologically active plants.

Insecticidal activity of following plant extracts recorded as 90 % or greater mortality within six days against Milkweed bug: *Galanthus elwesii* L., *Leucojum aestivum* L., *Narcissus tazetta* L., *Pancreatum maritimum* L., *Campanula trachelium* Lam., *Sinapis arvensis* L., *Bryonia alba* L., *Fumaria vaillantii* Lam., *Fritillaria imperialis* L., *Fritillaria persica* L., *Veratrum album* L., *Astragalus* sp., *Anemone coronaria* L., *Biphora radians* Bieb., *Ferula rigidula* DC., and *Oenanthe pimpinelloides* L. On the other hand, insecticidal activity of following extracts recorded 100 % mortality within six days against Yellow Fever mosquito: *Echium italicum* L., *Convolvulus arvensis* L., *Sinapis arvensis* L., *Onobrychis armena* Boiss. & Huet., *Maclura pomifera* L., *Veratrum album* L., *Reseda lutea* L., *Biphora radians* Bieb., and *Ferula rigidula* DC.

Nematocidal tests revealed 9 active extracts but with less overlap with either the insecticidal or brine shrimp lethality tests. Only 3 species possessed complete crossover toxicity with both brine shrimp and insecticidal activity namely, *Leucojum aestivum*, *Narcissus tazetta*, *Onobrychis armena*). Thus, differences between organisms and their sensitivity to the extracts is highlighted by the nematocidal tests. There seems to be a high convergence in susceptibility between insects and brine shrimp that is not shared with nematodes.

The following plant extracts gave complete mortality within 24 hours: *Leucojum aestivum* L., *Narcissus tazetta* L., *Anchusa azurea* Miller., *Crambe tataria* Sebeok., *Melilotus officinalis* (L.) Desr., *Onobrychis armena* Boiss. & Huet. ssp. *illyricus*, *Ranunculus arvensis* L., *Reseda lutea* L., *Daphne oleoides* Schreber.

Assays for antimicrobial activity yielded 13 extracts with antibacterial activity (24 % of extracts tested) and only 4 (7 %) with fungicidal activity. No crossover activity between bacteria and fungus was found. Although a few plant extracts demonstrated activity in both microorganisms and in multicellular animals conclusions suggesting any genuine crossactivity would be premature until the responsible natural products are characterized and retested. The following plant extracts signaled by a zone of inhibition of at least 4 mm against *Pseudomonas solanacearum* : *Echium italicum* L., *Cichorium intybus* L., *Convolvulus arvensis* L., *Crambe tataria* Sebeok., *Melilotus officinalis* (L.) Desr. *Onobrychis armena* Boiss. & Huet., *Alcea pallida* Waldst.& Kit., *Viscum album* L. ssp. *album* (Host. *Armeniaca vulgaris* Lam.), *Anemone coronaria* L., *Ranunculus illyricus* L. ssp. *illyricus* , *Reseda lutea* L., *Geum coccineum* Sm., *Oenanthe pimpinelloides* L. The following extracts signaled by a zone of inhibition of at least 1 cm<sup>2</sup> against *Cladosporium cucumerinum* : *Achillea millefolium* L., *Sinapis arvensis* L., *Biphora radians* Bieb. and *Ferula rigidula* DC.

## CONCLUSION

From the preliminary screening we have identified numerous extracts of Turkish medicinal plants with pharmacological activities against insects, brine shrimp, nematodes and microorganisms. We find significant crossover in activity among arthropod species but little crossover between arthropods, nematodes and microorganisms. Nevertheless, we identified 8 plant extracts showing broad spectrum activity in three or more bioassays. These include the plants: *Sinapis arvensis*, *Reseda lutea*, *Ferula rigidula*, *Convolvulus arvensis*, *Biphora radians*, *Veratrum album*, *Leucojum aestivum* and *Narcissus tazetta*.

Although selected from the records of indigenous plants used in Turkish folk medicine it is clear that the presence of pharmacologically active compounds in these plants has little to do with human medicine but represents plant evolution of defensive chemistry in response to competitive pressures from other organisms, especially insects, nematodes and pathogens. Nevertheless, folk practices have revealed certain plants with demonstrable pharmacological activity which may serve as a very useful guide to investigations focused on discovering new

chemistry that may be optimized into products for plant and public health protection from pests and diseases.

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