Past and Present Medicinal Uses of Selected Native Plants of Israel

[1]Zohara Yaniv, [2]Li Ailian, [3]Yona Tabib, [4]Ephraim Lev and [1]Dan Schafferman

Abstract

Six native desert plants of Israel were collected from their natural habitat: *Artemisia herba-alba*, *Achillea fragrantissima*, *Peganum harmala*, *Plantago coronopus*, *Retama raetam* and *Anabasis articulata*. All six plants have been known as medicinal plants since ancient times. A review of the literature on unknown regional medicinal records of the medieval period is documented; it confirms the importance of these plants. Extracts of the plants were assayed for their cytotoxic effects on *Petunia* cell lines: four leaf-extracts showed inhibitory activity; *Retama* was the most active, followed by *Peganum*, *Plantago* and *Artemisia*. *Achillea* and *Anabasis* showed no inhibitory effect. However, when *Anabasis* seeds were tested, both ethanol and water extracts were cytotoxic. The inhibitory effect, as demonstrated with *Retama* leaf-extract, was positively correlated with the concentration of the extract and the duration of the experiment.

Keywords: cytotoxicity, ethnobotany, desert plants, medicinal plants

Introduction

Plants have been known as a source of medicines and spices since the beginning of civilisation. This is due to the presence of metabolites with physiological activities. The origin and distribution of the natural products varies among species and families, as well as among plant organs, such as roots, leaves, fruits, seeds, etc. (Kaufman et al. 1999). It is assumed that the plants use these compounds to deter predators and pathogens, to attract and deter pollinators, to prevent competition from other plants for the same resources, and to defend themselves against environmental stress (Kaufman et al. 1999).

Israel is known for vast areas of arid land rich in plant species which are adapted to heat and drought stresses (Zohari 1982). One of the mechanisms of stress resistance is the synthesis and accumulation of unique metabolites in plant tissues (Yaniv et al. 1984, Yaniv & Palevitch 1981).

Mediterranean plants have been used effectively for centuries in traditional medicine. This traditional knowledge is well documented in the European herbal literature (Gunther 1968) and is currently the subject of chemical and biological research aimed at finding new sources of pharmaceutical drugs. However, it seems that the knowledge regarding the medicinal uses of rare desert plants did not reach Europe and much less is known about them.

We selected six desert plants known from the ancient herbal literature and searched for references to them in the regional, mainly Arabic, literature of the Middle Ages. They were then assayed for their cytotoxic effects.

Materials and Methods

Plant material

Plants were collected in the Sede-Boker area (desert region, rainfall: 50-100 mm/year) during the spring and summer of 1997. The following plants were collected: *Artemisia herba-alba; Anabasis articulata; Achillea fragantissima; Peganum harmala; Plantago coronopus; Retama raetam*. The plants were separated into leaves and stems, dried at 30°C for 3 days and ground to powder. In the case of *Anabasis*, the treated seeds were included separately. The

[1]Dept. of Genetic Resources and Seed Research, Inst. of Field and Garden Crops, ARO, the Volcani Center, Bet Dagan, Israel
[2]Inst. of Medicinal Plants, Chinese Academy of Medicinal Sciences, Beijing, China
[3]Dept. of Genetics, Inst. of Field and Garden Crops, ARO, the Volcani Center, Bet Dagan, Israel
[4]Dept. of Land of Israel Studies, Faculty of Jewish Studies, Bar-Ilan University, Ramat Gan. Israel

powder was stored until needed under vacuum at room temperature.

Preparation of plant extracts
1. Cold-water extract: Twenty-five grams of dried plant powder were extracted with 100 ml distilled water using a mechanical shaker overnight (110 rpm). The extract was filtered and the precipitate was extracted twice more: once with 100 ml H_2O and the second time with 50 ml H_2O. The total volume – 250 ml – was sterilised by filtration as described below. Final concentration: 0.1 g/ml.

2. Hot-water extract: twenty-five grams of dried plant material (ground seeds) were boiled in 200 ml distilled water for 2 h. After filtration, the precipitate was extracted twice more: once with 100 ml boiling water for 30 min and the second time with 50 ml boiling water for 30 min. The total volume was adjusted to 250 ml and sterilised as below. Final concentration: 0.1 g/ml.

3. Ethanol extract: Ten grams of ground, dried plant material were dissolved in 100 ml of 95% ethanol. The solution was stirred (100 rpm) overnight and then filtered through miracloth. The final volume was adjusted to 100 ml and sterilised by filtration as below. Final concentration: 0.1 g/ml.

4. Sterilisation: All extracts were sterilised by a two-step filtration through 25 mm diameter glass micro-fiber filters. The process was repeated twice. Dilutions were made with sterilised distilled water. Final concentrations used were: 0, 30, 70 and 100%.

No.	Source of extract	Method of extraction	Part of plant
1	*Retama raetam*	Cold water	Leaves
2	*Peganum harmala*	Cold water	Leaves
3	*Artemisia herba-alba*	Cold water	Leaves
4	*Achillea fragrantissima*	Hot water	Seeds
5	*Plantago coronopus*	Hot water	Fruits & seeds
6	*Anabasis articulata*	Hot water	Leaves
7	*Anabasis articulata*	Hot water	Seeds
8	*Anabasis articulata*	Ethanol	Seeds

Table 1. Extraction methods used during the experiments

Petunia cell suspension
A *Petunia* cell line designated *P. hybrida* Hook line 3704 was used in this study (Izhar et al. 1984). The suspension culture line was produced by growing surface-sterilised stem segments on solid UM medium. (Clark et al. 1985) until friable callus was formed. The callus was placed in liquid UM medium in sterile glass flasks on an orbital shaker at 110 rpm, and the suspension culture was grown at 26°C under continuous light.

Experimental procedures
The cell suspension was diluted with liquid UM medium to a final concentration of 1:1 liquid cell precipitate. Twenty-four ml of the suspension were then placed into glass flasks to which was added 1 ml sterile plant extract at one of the following concentrations: 0 (1 ml sterile water), 30, 70 and 100%. Twelve glass flasks were used for each concentration. The flasks were kept for 10 days on a shaker at 110 rpm at room temperature (26°C) under continuous light. At the start of the experiment (time zero), and on the 3rd, 7th and 10th days, three flasks from each concentration of plant extract were filtered and cells were weighed before and after drying at 70°C overnight.

Documentation of ethnobotanical data as a background for modern research
Ethnobotanical data relating to the selected plants were taken from Palevitch et al. (1986). Historical records from old and medieval medicinal manuscripts were also studied and citations of modern research publications, if any, were added.

Results and Discussion

Collection of ethnobotanical data as a background for modern research
All the selected plants are native desert plants typical to the southern regions of Israel. The selection was based on original ethnobotanical sources describing medicinal properties and uses in the Middle East from biblical times to the Middle Ages. This traditional knowledge has been preserved and passed on by the local herbalists; they are still active in herbal medicine until today.

The following is a summary of the information obtained on each of the selected plants.

Retama raetam: An aromatic shrub, mentioned in the Bible (I Kings) as "juniper", a desert plant whose roots were used for making coals (Psalms 120, 4-5; Job 30, 4). The upper plant parts are used in folk medicine as an external analgesic remedy, particularly for backache, eye pain and joint pain (Palevitch et al., 1986). It was also used externally by Asaf Harofe for the treatment of haemorrhoids, wounds and bites (Muntner 1965). A decoction of Retama raetam is known as a laxative, an abortifacient (in high doses) and as an emetic (Ibn al-Baytar 1875).

Peganum harmala: A small bush, very aromatic with white flowers resembling citrus and known in folklore for religious ritual and medicine since ancient times. The Greeks and the Romans used the seeds to treat blurred eyesight (Gunther 1968). It was used by Arabic physicians in the Middle Ages (10^{th} – 16^{th} centuries) to treat weak eyesight, headaches, joint aches and urinary problems, and to induce menstruation, (Ibn al-Baytar 1875; al-Qazwine 1981; al-Antaki Daud 1935; Ibn Sina 1877).
The Bedouin tribes in Israel use *Peganum harmala* as an abortifacient and for the treatment of amenorrhoea. Other medicinal uses are: steam bath for nerve problems, colds, coughs and respiratory problems. Crushed seeds in oil are used for the external treatment of infections and joint aches and are applied directly to the teeth for toothache. The seeds are also known as a source of a red dye (Turkey red), for carpets and turbans (Palevitch et al. 1986).

Plantago coronopus: An annual herb, found in many habitats all over Israel: fields, roadsides, waste lands and lawns. This species is not very well known in folk medicine, however, many other *Plantago* species have been used in medicine since the early civilisations. In ancient Egypt the plant was used to induce perspiration, to reduce fever and to treat digestive problems. In ancient Babylon *Plantago* was used to treat swollen legs. "Psullion" was prescribed by 1^{st} century Greek herbalist Dioscorides in his "Materia medica" for the treatment of fever, insect and snake-bites, headaches, ulcers, earaches and skin infections, and as a tranquillizer (Gunther 1968). In the Middle Ages some *Plantago* species, such as *P. major*, *P. ovata* and *P. afra* were used in the Middle East to treat coughs, backaches and rheumatic problems, internal inflammations, and as an aphrodisiac (al-Antaki Daud 1935; Ibn al-Baytar 1875; Ibn-Sina 1877). The same traditional uses are practised today in Israel (Palevitch et al. 1986).

Anabasis articulata: This is a dwarf shrub with a leafless stem and branches, found predominantly in the desert. According to Middle-Age sources, a powder named "ashnan" was made by burning the upper part of the plant to ashes. It was used as a soap, to treat haemorrhoids, and as an abortifacient and toxic medicine (al-Antaki Daud 1935; Ibn al-Baytar 1875; Ibn-Sina 1877). It is used in folk medicine in Israel, to treat urinary diseases, joint pains, lung problems, migraines and skin infections (Palevitch et al. 1986).

Artemisia herba-alba: An aromatic dwarf shrub with hairy grey leaves, common in the Negev and the Judaean Desert. The whole plant is very aromatic and rather bitter; in fact its bitterness is mentioned in the Bible (Amos 5,7 and Jeremiah 9,14). All *Artemisia* species are known to survive hard environmental conditions, many are also known as medicinal plants. In the literature of the Middle Ages as well as in folk medicine today, *A. herba-alba* is described as a healing beverage against intestinal worms and as a general stomach and gastro-intestinal remedy. Furthermore, it is mentioned as an antiseptic and anti-inflammatory medicine, for use against colds and coughs (steam bath), against diarrhoea (infusion of leaves and flowers), as well as for protection against bites of poisonous insects (Ibn al Baytar 1875; al Qazwine 1981; Palevitch et al. 1986; Crowfoot & Baldensperger 1932).

Achillea fragrantissima: A fragrant perennial shrub, common in the desert, it is named after the Greek hero Achilles who gave his wounded warriors an infusion of the leaves. Similar therapeutic uses are mentioned through the ages: in the 10th century – by al-Tamini, a Jerusalem physician; in the 13th century – by Ibn al-Baytar (1875); in the 16th century by al-Antaki Daud (1935); and in the present day, where the use of Achillea is well known among the local Bedouin herbalists of the Sinai desert. The main uses of Achillea are: antipyretic (steam bath), analgesic, specifically for joint pains (external use) and heart pain, stimulant and tonic (decoction) and for the treatment of diabetes.

The therapeutic potential of these desert plants has not yet been fully investigated, although research has been done on related species. The purpose of the present, preliminary study was to evaluate the antimitotic potential of these plant extracts.

Biological effect of plant extracts

Fig. 1 presents the effects of six plant extracts on the growth of *Petunia* 3704 cell lines. As can be seen, four of the six plant extracts inhibited the growth of *Petunia* cells in suspension. The effect was concentration-dependent. *Retama* extract was the most effective: it caused 40% inhibition of cell growth at 30% dilution and 60% inhibition when undiluted. Undiluted extracts of *Peganum*, *Plantago* and *Artemis*ia caused 40-50% inhibition of cell growth, while extracts of *Achillea* and *Anabasis* exhibited no inhibition.

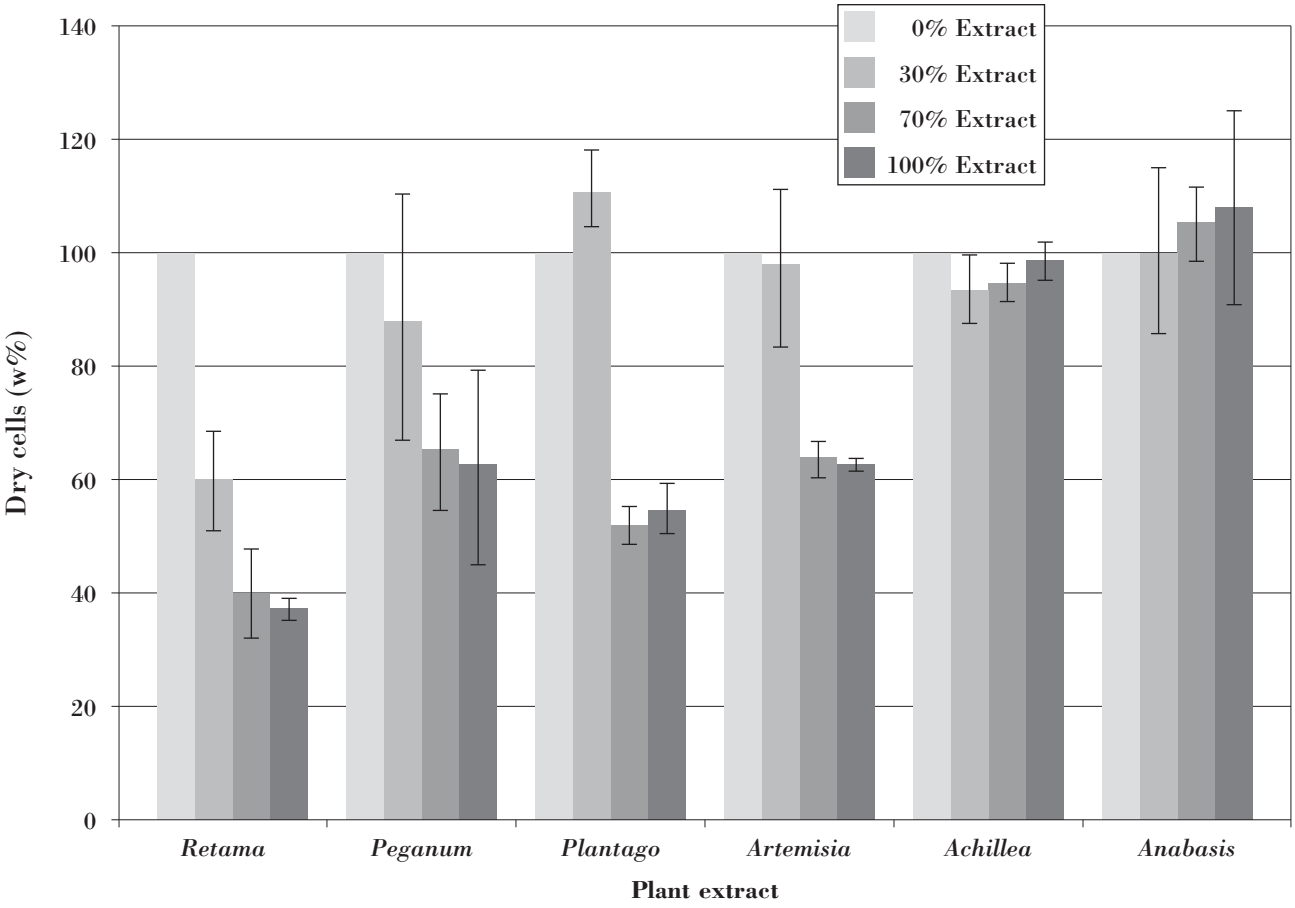

Fig. 1: The effects of six plant extracts on growth of *Petunia* 3704 cell suspension

Fig. 2 presents in detail the activities of aqueous *Retama* leaf extracts on *Petunia* 3704 cell suspension. As can be seen, during 10 days of growth, the *Petunia* cell lines showed maximum growth in suspension within the first 3 days of culture: the cell content more than doubled, from 0.15 mg/flask at the start of the experiment to 0.23 mg/flask after 3 days of cultivation in suspension, and the growth was maintained for the remainder of the experiment.

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