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Editorial

Global phytochemistry: The Turkish frame

Turkey is one of the most important countries in the temperate world, in terms of floristic diversity. The Turkish flora is estimated to contain more than 11,000 specific and infraspecific taxa of higher plants of which about 3000 are endemic (Davis, 1965-1988, 1971; Güner et al., 2000). This exceeds the total number of endemic species found in Europe and underscores the ecological importance of the country. Turkey is well known for its wide variation in topography and climate which favored the formation of different habitat and vegetation zones. Besides, ecological factors change greatly over very short distances and for these reasons living things have evolved and diversified richly and created a wealth of species. Turkey is also the home of many cultivated plants such as wheats, chickpeas, lentils, apricots, almonds, figs, hazelnuts, cherries and sour cherries. Additionally, a large number of ornamental flowers was cultivated from Turkish wild forms such as tulip, crocus, snowdrop, lily and fritillary.

The wide biodiversity of the flowering plants of Turkey is reflected in the 10-volume work – titled "Flora of Turkey and the East Aegean Islands" – of Prof. P.H. Davis of Edinburgh University (Davis, 1965-1988). Based on his numerous visits to Anatolia since 1938, Prof. Davis started publishing his monumental work in 1965. Publication of the flora was completed in 1985 with the 9th volume. However, new developments in the taxonomy of vascular plants of Turkey had caused the publication of the first supplement (Vol. 10) in 1988. Finally, 12 years after the publication of the first supplement, a second supplement (Vol. 11) was published in 2000 (Güner et al., 2000; Başer, 2002).

Additionally, during many historical periods Anatolia (Asiatic part of Turkey) served as a passageway between the continents of Europe, Asia and Africa. A variety of flora, fauna and culture owe their geographical spread to this passageway. A number of human races and tribes have come to settle in Turkey from various lands bringing their cultures, religions and customs for many centuries. This cultural heritage and richness of the flora have contributed to high diversity of traditional knowledge and practices of people to use the plants in their daily lives. In Anatolia, plants have been used as a source of food, remedy, animal fodder, tinder and some utensils from time immemorial. Ancient physician, pharmacologist and botanist Pedanius Dioscorides (c.40–c.90) was the first Anatolian inspired by this treasure and wrote a five volume book *De Materia Medica*, the first systematic pharmacopoeia, containing objective descriptions of approximately 600 plants and 1000 different medications. Dioscorides, born in a small town near Tarsus, was a product of the classical world of Greece and Rome. He flourished during the time of Nero. Travelling widely, he studied plant life wherever he journeyed, eventually his writing became the most influential herbal ever written. For over 1500 years his work was considered as the final authority on the pharmaceutical use of herbs and plants. The modern science of pharmacology can be traced back to Dioscorides' efforts to systematize the knowledge of material medicine.

Unfortunately, this ethnobotanical experience, which passed on from generation to generation, is rapidly being lost with the modernization of society, especially by the development of road communication, the migration of people from villages to cities and the accessibility of modern medicine. But it is reported that Turkish people – mostly the people live in rural areas still use traditional medicine for their health care practices (Baytop, 1999). This valuable ethnomedicinal knowledge and the rich flora can be a source of income for Turkey and provides an incentive to conserve the biodiversity.

Özhatay et al. (1997) and Atay et al. (2000) have documented the commercial trade in medicinal plants, identifying more than 300 taxa either in internal commerce or exported (Fig. 1). On average, Turkey exports nearly 30.000 tons of medicinal and aromatic plants annually, generating approximately USD 50 million in foreign income. Wild collection plays still a vital role in the trade of medicinal and aromatic plants. In general, prices for material from wild plants are much lower than for

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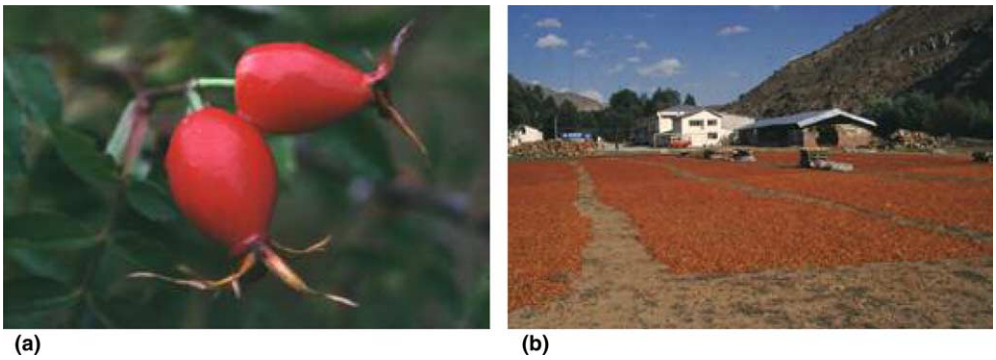

Fig. 1. Rosehip is commonly used in traditional medicine and cuisine. (a) *Rosa dumalis* Bechst. subsp. *boissieri* (Crèpin) Ö. Nilsson, Giresun area, N. Anatolia. (b) Drying process in rosehip syrup factory, Gümüşhane area, N. Anatolia (Photograph by M. Coşkun).

material of cultivated origin. Nearly % 100 of the medicinal and aromatic plant material in trade in Turkey is wild collected – only c.25 are cultivated. Collectors of these plants are in main, rural people, stock-herders, villagers and retired people for whom it provides in most cases a supplementary income. In a national project (Özhatay et al., 1997), many species (such as; *Gentiana lutea*, *Glycyrrhiza glabra*, *Gypsophila* sp., Orchidaceae species collected for salep, *Ruscus* sp., *Sideritis* sp., *Thymus* sp., *Origanum* sp.) (Figs. 2 and 3) were reported to

Fig. 2. Gypsophila sp. (''çöven'') were reported to be threatened as a result of over-collection. (a) Unearthed roots of *Gypsophila graminifolia* Bark. (b) Collection of the roots of *Gypsophila bicolor* (Freyn & Sint.) Grossh.,Van area, E. Anatolia (Photograph by M. Koyuncu).

Fig. 3. *Sideritis congesta* P.H. Davis & Hub.-Mor., (''mountain tea''). (a) Bunches after collection (by Prof. Coşkun). (b) The herb is commonly favored as tea, Alanya area, S. Anatolia (Photograph by M. Koyuncu).

be threatened as a result of over-collection from the wild. Unfortunately, trade of medicinal and aromatic plant species is largely unmonitored and public awareness of this trade and its impacts on the plants involved is slight. Levels of trade are unsustainable in many cases. Despite this, there are several measures for avoiding potential danger, or for reversing existing threats to a species, including in situ conservation, trade controls and cultivation projects. This requires co-ordinated conservation work involving conservation experts, specialised scientists, government and all aspects of trade. Trade monitoring, adjustments to legislation, regulation in situ and ex situ protection, improved management programmes, public awareness initiatives; enhancement of cultivation efforts and certification of plant material from sustainable sources are the main titles under this effort. Turkey is also a signatory country of the following international agreements whose objectives include conservation of the flora; Convention on Biological Diversity, Bern Convention and CITES (Convention on International Trade in Endangered Species).

The list of Endangered, Rare and Endemic Plant species was first prepared by Ekim (Ekim et al., 1989) according to the IUCN (The World Conservation Union) criteria. After 10 years, 62 new species, which were previously categorized as indeterminate or insufficiently known have been re-categorized and finally Red Data Book of Turkey was published again (Ekim et al., 2000). Under the title of ''Protection of Species in Turkey'', seeds of more than 2000 endemic plant species have been collected through a comprehensive project supported by TUBITAK (The Scientific and Technical Research Council of Turkey) and DPT (State Planning Organization) in 1992–1997 with the participation of 30 researchers from 16 different universities (Ekim, 1998). The collected seeds have also been transferred to the Gene Bank in Menemen (in Western Turkey) for ex situ protection. It is widely recognized that a strategy of ''conservation through use'' by which plant collection from wild is replaced by controlled cultivation, is the best way forward if we are to balance human demands with the necessary conservation of the biodiversity represented by these species. That provides one major driving force for research in this field. Another concerns the very real need for improving the quality control of products on the market, both to satisfy international trade demand and to conform with increasing requirements for standardization and precise identification of the composition of the plant materials being sold for human use (Johnson and Franz, 2002).

As it was mentioned before, trade in medicinal and aromatic plants is a commodity trade involving hundreds of species and thousands of tonnes annually, and has a much larger scale than the other kinds. This trade also has strong health care implications leading to an increasing public and media awareness of these issues. Despite this vast amount of continuous trade, there is a tremendous lack of information on the part of stakeholders with respect to knowledge about the plant resources used, their sustained harvest levels or ability to recover. Because the information about the sustainable collection and trade of medicinal plants and aromatic plants in Turkey is scattered in a range of different works (Özhatay et al., 1997; Ural, 2002), more knowledge has to be accumulated in a coordinated fashion and it has to be made available to all stakeholders with the aim to provide basis for integrated management plans.

While modern or western medicine remains the mainstreams of health care in the country, during the past decade, the utilization of traditional medicine has increased sharply, partly because formal health care became less affordable due to the economic crisis. Apart from some experimental exceptions, in Turkey, traditional and modern health care services are not integrated; they merely co-exist. Traditional systems of medicine still are contributing significantly to the medical needs of about 70–80% of the world's population, although modern medicine has dominated most of the health care systems in the world. Recognizing its importance, integration of traditional medicine into primary national health care system would faciliate more efficient use of the domestic resources. Application of modern scientific knowledge and techniques i.e., research of traditional medicinal plants by chemical, physiological, pharmacological and biochemical studies is a starting point of integration. In Turkey, investigation of the chemical composition of the natural products is one of the major research fields in the faculties of pharmacy. Phytochemical research on Turkish plants are conducted in departments of Pharmacognosy and Pharmaceutical Botany of the faculties of pharmacy. In Ankara: Ankara University, Faculty of Pharmacy; Hacettepe University, Faculty of Pharmacy; Gazi University, Faculty of Pharmacy, in İstanbul: Istanbul University, Faculty of Pharmacy and Marmara University, Faculty of Pharmacy, in Izmir: Ege University, Faculty of Pharmacy, in Eskişehir: Anadolu University, Faculty of Pharmacy are the leading research centers on the phytochemistry in Turkey. Essential oils, flavanoids, coumarins, iridoids, alkaloids, saponins, fixed oils, anthraquinones, terpenes, anthocyanins, tannins, phenylpropanes and lignans are the groups of major constituents mostly studied. Under the titles of these groups, many known and new compounds were isolated and identified. Biological activity on many of these compounds were studied. New compounds from plants growing in Turkey reported until the end of 1999 were listed in the book titled ''New Compounds from Plants of Turkey'' (Başer and Kırımer, 2002). Although the level of publication in phytochemical field is relatively high, it is not possible to say the same for biological

activity studies. Nevertheless, there are also some sophisticated works in the field of biological activities of plants and natural compounds; in a research composed by Şener et al. (2003), four groups of Amaryllidaceae alkaloids, namely lycorine-, crinine-, tazettine-, and galanthamine-type, as well as plants extracts of Amaryllidaceae plants (*Pancratium maritimum*, *Leucojum aestivum*, and *Narcissus tazetta* ssp. *tazetta*) growing in Turkey were evaluated in vitro for their ability to inhibit *Plasmodium falciparum* growth by a high-throughput screening method with a 96-well microtiter plate. 6-Hydroxyhaemanthamine, haemanthamine and lycorine were found to be the most potent alkaloids against *P. falciparum* (T9.96) and galanthamine and tazettine had the least potent activity against *P. falciparum* (K_1). In another work, Kırmızıbekmez et al. (2004) investigated the inhibiting activities of the secondary metabolites of *Phlomis brunneogaleata* against parasitic protozoa and plasmodial enoyl-ACP reductase, a crucial enzyme in fatty acid biosynthesis and found some promising compounds. In a joint research (Enomoto et al., 2004), the inhibitory effects of 40 extracts prepared from 38 traditional Turkish folk medicines on human aldose reductase (h-AR) and hematological activity were investigated. Seven plants containing 5 species of *Cistus* genus exhibited a potent inhibition of h-AR. *Ferulago amani* (root) inhibited the platelet aggregation induced by sodium arachidonate, while *Cistus laurifolius* (fruit) was found to possess strong inhibition in the blood coagulation assay. An AcOEt extract derived from the leaf of *C.laurifolius* was purified to isolate three known flavonoids. The activity of one, quercetin-3-*O*-methyl ether, was found to be as potent as that of eparlestat, which is known to be a remedy for treating complications associated with diabetes.

In Turkey, in order to encourage the collaborative exchange of information and experience between the researchers in the field of medicinal and aromatic plants, a serial of symposium titled ''Symposium on Plant Originated Crude Drugs'' has been held in every two years since the first meeting in İstanbul, 1976. The last and the fifteenth of these meetings was held in Antalya as a three-day event on October 6–9, 2004 with a high level of participation. Altogether, 116 scientific presentations (3 plenary, 17 oral, 96 poster) were made during the meeting by the researchers representing institutions in Turkey and by two foreign internationally recognized scientists. The topics of this meeting were ethnobotany and folkloric medicine, pharmacognosy, pharmaceutical botany, chemotaxonomy, microbial biotansformation, biological activity of medicinal plants and natural products, isolation and structure elucidation of bioactive plant secondary metabolites, biosynthesis, drug discovery, bioassay development, official pharmacopeial monograph development, organic synthesis, quality control and medicinal plant cultivation. This meeting in Antalya has generated a great deal of scientific momentum and created a new platform and opportunities especially for young scientists to broaden their scientific perspectives and experiences by paying testimony to the richness of natural sources of Turkey to be discovered.

EU, by importing more than 100.000 tonnes of plant raw material annually, plays a major role in the expanding markets for plant raw materials. European countries act in both ways: As countries of harvest and export (Bulgaria, Spain), to much greater extent, however, many countries, especially in EU, are centers of import and consumption. In a global comparison, despite all of the advances made in medicine, herbal medicines remain popular also with the public in ''developed'' countries. Public skepticism of the inability of allopathic medicines to be free from adverse effects, or to cure chronic conditions, have contributed to consumer demands for high quality herbal medicinal products (HMP's). Advances in chemical and biological techniques during the past 50 years have resulted in scientific evidence to substantiate the use of many herbal products and have enabled manufacturers to produce standardized HMP's. The regulatory control of HMP's varies in Member States of the European Union (EU) and has led countries to amend them and to consider proposals for future European legislation. In 1987, the European Parliament called for ''scientific approach to phytopharmaceuticals''. The European Pharmacopoeia Comission responded by elaborating modern monographs on herbs for inclusion in the European Pharmacopoeia (Phillipson, 2003). Turkey, as a full member country candidate did some reforms and moved a step closer to joining the European Union, also needs to take stricter measures in HMP's.

Seeing all these, TUBITAK has recently conducted a national project about the most important 15 genera exported. Under the umbrella of this project, the specialised scientists have been studied on the wild species exported extensively. The objective was to determine the chemical characterization, the conservation status, how intensively wild species are harvested, how extensively they are cultivated and what are the existing and potential markets (local, national and international). The results of this project implies the necessity of urgent realising of the following measurements;

1. Formulation of a clear policy for the production, transport and marketing based on the local and international needs of medicinal plants raw materials.
2. Coordination between all sectors (ministries, organizations, universities, institutes and research centers) concerned with medicinal plants.
3. Survey of medicinal and aromatic genetic resources and establishment of gene resource banks.

4. Establishment of pharmaceutical industries based on medicinal and aromatic plants.
5. Support of research on medicinal plants, training of technical staff and improvement of production techniques.
6. Formulation of extension programs for rural people on the importance of traditional knowledge and the conservation of medicinal and aromatic plants.
7. Cultivation of medicinal plants.
8. Protection of endangered species.
9. Implementation of breeding programmes for raising the productivity of the medicinal plants.

With this recognition; our country needs new projects work in collaboration with traditional healers, researchers, non-governmental organizations, decision makers and traders in order to create viable policy options for the sustainable development of medicinal plants.

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