Journal of Ethnopharmacology, 38 (1993) 121–128
Elsevier Scientific Publishers Ireland Ltd.

Botanical methods in ethnopharmacology and the need for conservation of medicinal plants

Inga Hedberg

Department of Systematic Botany, Box 541, S-751 21 Uppsala (Sweden)

An imperative demand imposed on all scientific investigations is that they should be repeatable, which calls for adequate documentation from the very beginning. In medicinal plant research, botanical documentation plays a vital role since without correctly identified material and properly documented voucher specimens the results are at best suspect and at worst useless. The botanical contributions required for ethnopharmacological research thus include adequate naming of the material and deposition of properly labelled voucher specimens in at least two public herbaria. Ethnopharmacology depends, however, upon botanical assistance also in another respect, viz. concerning conservation. This field may seem to have little to do with ethnopharmacology, but without joint efforts to save the useful plants from extinction, ethnopharmacology will lose important parts of its main source at an appalling rate.

Key words: documentation; herbaria; inventory; identification; synonymy; conservation

To a botanist 'Botanical methods in ethnopharmacology' are so fundamental that they should be well known to all and everybody involved in research on medicinal plants. However, a definition quoted by Schultes (1991) indicates that this is not the case, since it reads: Ethnopharmacology has recently been defined as 'the observation, identification, description and experimental investigation of the ingredients and the effects of indigenous drugs'. Ethnopharmacology is, however, a highly interdisciplinary field where botany plays a vital role, and to leave out the identification of plants yielding those indigenous drugs is to leave out the very base for ethnopharmacological research.

Also experiences from contacts with a Swedish medical doctor involved in a project on traditional medicine in an African country show that much remains when it comes to the planning and accomplishment of such programmes.

A further reason for highlighting the role of botany and botanists in ethnopharmacological research is that recent trends within systematic botany itself jeopardize future availability of the kind of botanical expertise essential for such research. In recent years molecular biology has been given priority in several branches of biology, to such an extent that in botany it has ousted traditional botany more or less completely. All over the world there is a profound tendency to neglect 'green botany' in favour of laboratory and computer oriented activities. Field oriented, experienced 'whole plant botanists' are, however, indispensable for all applied sciences dealing with plants (see House of Lords 1st Report, 1991–1992).

To focus on botany in ethnopharmacology is badly needed also because botanical knowledge and methodology is essential for the conservation of medicinal plants. Though conservation is a very important matter the need is seldom expressed or even touched upon at pharmacological conferences. The reason might be that conservation is not regarded as pure science, but on the other hand it is vital for the future of ethnopharmacological research: the threat to many species used for medicinal purposes is very grave and if the scientists do not care about conservation, many species might become extinct in the near future. Discoveries of interesting substances in plant material are of little use if the species concerned has in the meantime become extinct.

Botanical methods

It is a well known fact that the evaluation of traditional medicine varies very much depending on which part of the world we are dealing with. Whereas in some parts, e.g. the tropics and China,

Correspondence to: Inga Hedberg, Department of Systematic Botany, Box 541, S-751 21 Uppsala, Sweden.

0378-8741/93/$06.00

TABLE I

PROGRAM FOR STUDIES OF PLANTS IN TRADITIONAL MEDICINE

From Samuelsson (1988).

A.	Inventory and botanical identification
B.	Studies of the literature
C.	Pharmacological screening of extracts
D.	Isolation and identification of pharmacologically active constituents
E.	Pharmacological studies on isolated substances
F.	Toxicological studies
G.	Clinical testing
H.	Production of drugs

traditional medicine has always held a strong position, this is not the case in the USA or in most parts of Europe. The evolution of modern, school, medicine, in those parts meant that traditional medicine, including medicinal plants, was looked upon with disregard or even contempt by the medical society. Though this attitude now seems to be gradually changing it is still with us, to a considerable extent (see below).

The reawakening of the interest in plant substances in the industrialized countries together with the rapidly growing interest in developing countries to start research programmes in ethnopharmacology also makes it imperative to secure and widen the knowledge about the importance of botany in such research.

The basic role played by botany in research dealing with plant substances is demonstrated in Table 1. But botanical expertise is needed not only for *identification* but also for *inventories* and *documentation* — all three closely interwoven, since inventories are meaningless and safe identification impossible unless proper documentation is achieved simultaneously.

Inventories

Let us then start from the very beginning, the inventories, which include the sometimes rather laborious field work. This is certainly not a one-man job but team work which should ideally include at least one botanist, one ethnopharmacologist and local traditional healers. The information from those healers is essential since the possibility of finding active substances is much greater if plants used by the healers are investigated, than if plants are sampled at random (Spjut and Perdue, 1978). In order to secure proper documentation, a standardized form (Fig. 1) should be filled in for each collection, giving the scientific (Latin) name of the plant (if possible), vernacular name, locality, part(s) of plant used, administration, etc.

Material of each species to be investigated must be put in a press to serve as voucher specimens for safe identification and future reference. Preferably at least two sheets should be secured of each collection to be later housed in different institutions. In the tropics, where the material may be exposed to serious attacks by insects and other pests, at least three sheets must be secured. If conditions are safe, those sheets might be kept in the country of origin, like in the INBIO project in Costa Rica where one sheet with all information available is kept in a strong room, one goes to the INBIO herbarium and one to the university (A. Sitenfeldt, pers. commun.). Where conditions for safe storing of specimens are less suitable vouchers should be kept at least in one institution in the country of origin but also sent to institutions in temperate regions where the risk of damage to the material is much less. Voucher specimens must be as complete as possible with flowers and/or fruits and, for herbs, also roots. This is particularly important for tropical material which often poses special difficulties in identification. From trees twigs, flowers, and bark should be taken and details on slash, etc. given in the forms. Since the main part of the information recorded in those forms is essential for further pharmacological research, important details dealing with the plant from a botanical point of view should later be copied on the label prepared for the herbarium specimens because such details may be of great help in naming them.

Identification

After the field work has been completed the most urgent task is the identification of the specimens collected, which again makes the availability of botanists crucial. Whereas some material may be named without any particular difficulty, identification could in other cases be time-consuming and sometimes very difficult.

Due to ignorance in this field, people, not least scientists, are often completely unaware of the problems involved in this task. In Sweden, for example, with its poor flora of about 1600 species of higher plants, where the famous Carl Linnaeus started to name and classify them more than 200 years ago, and where there are a number of floras covering the whole country, and a lot of local floras, there should be no difficulties in naming plants or plant collections.

Date:_____ **Collection SMP no.**_____

1. Locality: District_____ Village_____

Distance and direction from major town_____

Longitude/latitude_____ Habitat_____

_____

2. Type of plant:

Tree Herb Parasite

Shrub Liana Aqueous plant

3. For trees: Height & bulk_____ Bark description_____

Slash_____

4. Flower colour:_____ **5. Fruit description:**_____

6. Smell:_____ **7. Latex present**_____

8. Attacked by insects etc.: _____

9. Provisional identification:_____

10. Vernacular name:_____

11. Name of traditional healer:_____

12. Preparation of remedy:

Plant part_____ Fresh_____ Dried _____

Amount taken _____

Crushed_____ Powdered_____Mixed with water (amount)_____

Cold water_____Boiled_____Boiling water poured over_____

Mixed with other vehicle (amount)_____

Other preparation _____

13. Dose and regimen:_____

_____

14. Disease or symptoms treated: _____

_____

15. Plant used together with the following plants: (Vernacular name or SMP-number. Part of plant. Note amount of plant part taken in preparation or other details if preparation differs from description in **12** above).

_____

_____

_____

_____

_____

17. Additional notes:

_____

_____

_____

_____

Fig. 1. Form suggested for field inventories in ethnopharmacological research (Samuelsson et al., 1991).

TABLE 2

EXAMPLES OF THE USE OF THE SAME VERNACULAR NAME FOR DIFFERENT SPECIES

Extracted from Kokwaro (1976).

Language	Vernacular name	Scientific name	Family
Digo	Kibombo	*Dissotis rotundifolia*	Melastomataceae
		Rauvolfia mombasiana	Apocynaceae
Digo	Kamata	*Aerangis thomsonii*	Orchidaceae
		Culcasia scandens	Araceae
Kamba	Kawala	*Rubia cordifolia*	Rubiaceae
		Stapelia semota	Asclepiadaceae
Kipsigis	Lemeiywet	*Ozoroa incano*	Anacardiaceae
		Syzygium guineense	Myrtaceae
Ngoni	Mambahuru	*Cardiogyne africana*	Moraceae
		Cissus rotundifolia	Vitaceae

In tropical countries, e.g. Tanzania or Colombia, with about 10 000 and 30 000 species, respectively, with a considerable number unknown to science, and with floras covering only a portion of the plant families, the situation becomes vastly different. The naming of a specimen in the field quite often offers considerable difficulties or is impossible. In such cases the vernacular name may be used as a reference, to be later replaced by the scientific name. It is then extremely important to be aware of the fact that the same vernacular name sometimes is applied to different species, as exemplified in Table 2, which shows that the same vernacular name may refer to species from fairly distantly related families. Differences in pronunciation may sometimes reveal to which species reference is made, but such a difference will obviously not be traceable from a written form.

On the other hand, different vernacular names are sometimes used for the same species as shown in Table 3. If a voucher specimen is not available this might cause considerable confusion.

TABLE 3

EXAMPLES OF THE USE OF DIFFERENT VERNACULAR NAMES FOR THE SAME SPECIES

Language	Vernacular name	Scientific name	Family
Digo	Mungwene	*Uvario acuminata*	Annonaceae
	Msalansi		
Shambaa	Mnkande	*Kigelia africana*	Bignoniaceae
	Mvugve		
	Mvungunya		
Digo	Mserere	*Hoslundia opposita*	Labiatae
	Msettette		
	Mtambaajongoo		
	Mvuma		
Shambaa	Mshwee		
	Mshwelele		

TABLE 4

LIST OF SYNONYMS FOR *COMBRETUM COLLINUM* FRESEN.

Combretum abercornense Exell
C. album De Wild.
C. angustilanceolatum Engl.
C. bajonense Sim
C. binderanum Kotschy
C. brosigianum Engl. & Diels
C. burttii Exell
C. elaeagnifolium Oliv.
C. elgonense Exell
C. sp. near *C. elgonense* sensu Burtt Davy
C. fischeri Engl.
C. flaviflorum Exell
? *C. frommii* Engl.
C. gazense Swynn. & Bak. f.
C. goetzenianum Diels
C. hypopilinum Diels
C. kabadense Exell
C. karaguense Engl. & Diels
? *C. kerengense* Diels
C. kottoense Exell
C. laboniense M.B. Moss
C. makindense Engl.
C. mechowianum O. Hoffm. subsp. *gazense* (Swynn. & Bak.f.) Duvign.
C. mechowianum O. Hoffm. subsp. *taborense* (Engl.) Duvign.
C. mwanzense Exell
? *C. oliveranum* Engl.
C. populifolium Engl. & Diels
C. psammophilum Engl. & Diels
C. ritschardii De Wild. & Exell
C. singidense Exell
C. suluense Engl. & Diels
C. taborense Engl.
? *C. truncatum* Engl.
C. verticillatum Engl.

For definite naming it is also in many cases necessary to compare the voucher to adequately named material in a large herbarium.

Synonymy

Because of the very long history of the use of medicinal plants and the comparatively short history of the scientific study of such plants we are to-day facing a serious lack of routines in various respects. The securing of vouchers has been — or is — one, the necessity to find out and use the correct scientific name is another. Botanical revisions of various plant families or groups often reveal that a widespread tropical species has been described by different botanists under different names. This is partly because collecting expeditions in earlier days were organised by a number of European countries in their respective colonies and that the material brought home was worked up without sufficient contact between botanists from different countries, partly because the material available was too scarce to reveal the continuous variation that often existed. Thus for many species a number of synonyms have accumulated, the amount of which may sometimes be rather impressive, as shown in Tables 4 and 5. In the case of *Combretum collinum* 30 synonyms have been listed, all under the generic name *Combretum*. For *Maytenus heterophylla* no less than 42 synonyms are listed, only three of which are given

TABLE 5

LIST OF SYNONYMS FOR *MAYTENUS HETEROPHYLLA* (ECKL. & ZEYH.) N.ROBS.

Cassine szyszylowiczii Kuntze
Catha buxifolia (L.) G. Don
C. cymosa (Soland.) C. Presl.
C. heterophylla (Eckl. & Zeyh.) Presl.
Celastrus andongensis Oliv.
C. angularis Sond.
C. buxifolius L.
C. cymosus Soland.
C. ellipticus Thunb.
C. empleurifolius Eckl. & Zeyh.
C. goniecaulis Eckl. & Zeyh.
C. heterophyllus Eckl. & Zeyh.
C. humilis Eckl. & Zeyh.
C. multiflorus Lam.
C. parvifolius Eckl. & Zeyh.
C. patens Eckl. & Zeyh.
C. polyacanthus sensu Eyles
C. polyanthemos Eckl. & Zeyh.
C. rhombifolius Eckl. & Zeyh.
C. spathephyllus Eckl. & Zeyh.
C. venenatus Eckl. & Zeyh.
Elaeodendron glaucum sensu Szyszyl
Gymnosporia acanthophora Loes.
G. angularis (Sond.) Sim.
G. brevipetala Loes.
G. buxifolia (L.) Szyszyl.
G. buxifolioides Loes.
G. capitata var. *tenuifolia* Loes.
G. condensata Sprague
G. crataegiflora Davison
G. elliptica (Thunb.) Schonl.
G. glauca Loes.
G. heterophylla (Eckl. & Zeyh.) Loes.
G. maranguensis (Loes.) Loes
G. rhombifolia (Eckl). & Zeyh.) Bolus & Wolley-Dod
G. senegalensis var. *maranguensis* Loes.
Gymnosporia trigyna sensu Perrier
G. uniflora Davison
G. woodii Szyszyl
Maytenus angalensis Exell & Mendonça
M. brevipetala (Loes.) Wilczek
M. cymosa (Soland.) Exell

under the generic name *Maytenus*, the others under 6 other generic names.

The establishing and handling of such synonym lists may be very time-consuming, but unless full synonymy is given, tedious and expensive analyses and tests might be unnecessarily repeated in species which have already been subjected to detailed investigations under a different species name.

Documentation

Another focal point in ethnopharmacology is the need for documentation, an aspect which has been badly neglected in far too many investigations. Striking examples are given by Farnsworth and Morris (1976) of very expensive and elaborate research turning out to be completely wasted because of inadequate documentation.

An imperative demand on every scientific investigation is that it should be repeatable, and one of the most difficult problems in research on medicinal plants is that analysis from a second batch of material often gives discordant results compared with the first analyses. This may in some cases be due to variation from one lot to another in the concentration of active substances, but is probably more often due to the fact that the second sample was taken from a different species. Such failures can only be avoided if documenting collections with complete voucher specimens are secured of all plants investigated and information on these vouchers is published with each report on active substances. The inclusion in every report of information on the plant material used — collector, collection number and the herbarium in which the vouchers are housed — offers the only possibility of checking the identity of a plant and making sure that the same species is investigated on a later occasion.

The extreme importance of vouchers should thus be obvious to every scientist, and according to recent information no reputable journal would accept a paper for publication if this information is missing. But only about 15 years ago Farnsworth and Bingel (1977) reported the following from a survey of the 1975 literature dealing with the isolation of new chemical entities from higher plants: 'Only 160 of the 2399 novel chemical compounds reported were isolated from plants for which the author(s) indicated that a voucher specimen was available for reference to the plant material investigated. There is even a 1975 paper, published in a reputable chemical journal, in which a new compound was reported to be isolated from a plant that was identified only as 'probably belonging to the Menispermaceae!'.

It goes without saying that investigations carried out on material not properly identified and documented are of little if any use, since it is impossible to know with certainty the source of the chemical compound.

To sum up: For successful inventories and utilization of plants in ethnopharmacological research the following precautions must be taken:

- To secure good voucher specimens, in temperate regions at least two sets, in the tropics at least three, properly documented with collector, collection number and locality. This information must be given in each report together with references to herbaria where vouchers are deposited.
- To give, in standardized form, information on locality, habitat, use, administration, etc., thus making it possible to re-collect the species and to use the information given by traditional healers.

For a satisfactory organisation of ethnopharmacological research — and for that matter also on all other plant related projects — the botanical infrastructure required is:

- A well equipped herbarium where specimens can be named and vouchers kept for indefinite periods.
- A well trained herbarium staff, to handle the collections and prevent them from being destroyed by insects or other pests.
- Scientifically trained botanists capable of dealing with the naming, checking of synonyms, etc.
- A well equipped library with floras and other literature to make it possible for botanists to name specimens belonging to families or groups with which they are not familiar.

Only if those resources are available can ethnopharmacological research on plants be successfully carried out.

Conservation of medicinal plants

At first sight ethnopharmacological research may seem to have little to do with conservation of medicinal plants. Bringing this up at a congress otherwise strictly devoted to ethnopharmacology

makes me recall Cato the elder (234–149 B.C.), who — regardless of the subject he was talking about — is reported always to have finished his speech with the words: 'praetera censeo Carthaginem esse delendam', i.e. 'besides, my opinion is that Carthage must be destroyed'. But whereas many times Cato's remark was completely irrelevant in relation to the subject treated, my message should be communicated at each conference dealing with plant material to remind scientists not only of the vulnerability of much of their research material but also of the need for urgent action. The subject has in recent years been touched upon at several conferences and in a number of publications, e.g. Hedberg (1987), Maheswari (1988), Akerele et al. (1991), but it seems as most of the appeals for action are either like preaching to those already converted or falling to deaf ears. If we — as again pointed out at a recent conference on 'Systematics and conservation evaluation' — are going to witness a mass extinction of medicinal plants in the next few decades, this will be a catastrophy for people in the developing countries, where at present about 80% of the population depend on traditional medicine. It would also be disastrous for ethnopharmacologists, for science as a whole, and for humankind, not least since only a fraction of all higher plant species have been properly investigated (Farnsworth and Soejarto, 1991).

Obviously, ethnopharmacologists like all other scientists working in basic or applied sciences dealing with plants, have a heavy responsibility to help save as much as possible of botanical biodiversity. But to get the message across in such a way that it really has an effect seems to be extremely difficult, not least because scientists either are not interested in communicating with society or lack the ability to do so. This problem has been treated by Wachtel (1991) in a paper with the significant title 'Let's stop talking to ourselves: the need for public awareness'. Such a call certainly requires a more broad-minded approach than is usually demonstrated by representatives of our modern scientific community.

There is probably nothing wrong in glorifying the advances made in modern medicine during the last few decades but this should certainly not be done by concealing at the same time the fact that much of to-day's medicine is founded on experiences and knowledge inherited from earlier days and from many years of research on plants.

Let us go back to the introductory remark on the approach to traditional medicine in our part of the world and see how it was treated only a few years ago (Fig. 2). The pamphlet was issued by the National Corporation of Swedish Pharmacies and available in all pharmacies in Sweden.

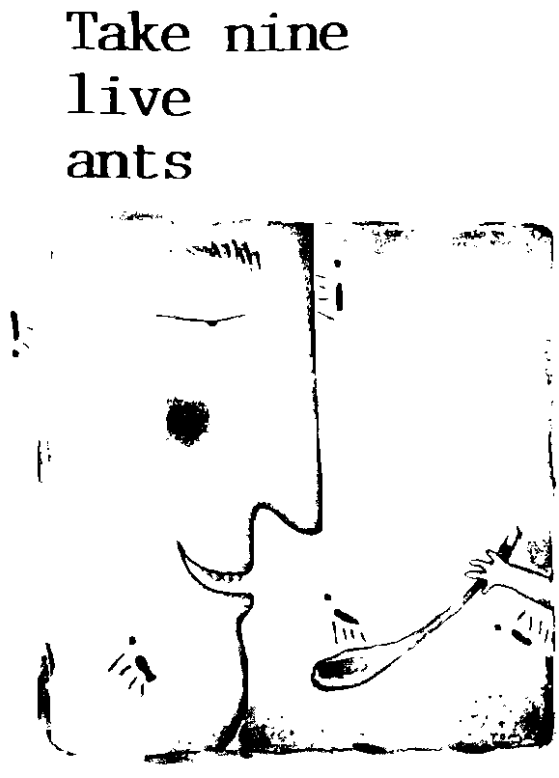

Fig. 2. Pamphlet on modern medicines issued by the National Corporation of Swedish Pharmacies and published by their permission. (Text translated by the author.)

Even if the pamphlet was intended in the first place to give information about to-day's pharmaceutics it is difficult to understand why this had to be done in a way that immediately throws an air of ridicule over what in fact has been extremely important for the success of pharmacological research. One might well ask why such an absurd example from traditional medicine was chosen.

In a pamphlet like this, wouldn't it have been appropriate to acknowledge the immense importance of the use of plants in medicine, taking into account that 25–30% of all western medicines still are derived directly or indirectly from higher plants, that a large amount of our medicines today have been synthesized using naturally occurring substances in plants as a model, and that — in spite of great efforts over many years — it has still

proved impossible to synthesize a considerable number of active substances used in to-day's medicine.

There seems also to be an unfortunate and pronounced tendency amongst scientists trying to design various compounds to forget or leave out that they often use natural products as models for their syntheses. In this way the fundamental role played by plants in such research remains unknown to the media and consequently also to the general public.

This tendency has to be counteracted but it appears that up to now ethnopharmacologists have been less apt actively to challenge the distortion caused by some recent trends in pharmacological research. It is obviously high time actively to draw the attention of society to the role of ethnopharmacology in the development of pharmaceutics. Unfortunately, statements like those of Mangelsdorf in 1972, correcting his 1941 prediction that in another 25 years drugs of plant origin would be of little more than historical interest, or publications like that by Farnsworth and Morris (1976): 'Higher plants — the sleeping giant of drug development' do not reach those who in the first place should be informed.

A policy must be worked out to make the value of plants clearly visible to decision makers and the general public. This could be done by joining forces with botanists, i.e. whole plant botanists, and conservationists, thus safeguarding the conditions for ethnopharmacological research. This would also draw attention to the value of traditional knowledge and assist in the conservation of this knowledge and the plants which may be vital for our survival.

References

Akerele, O., Heywood, V. and Synge, H. (Eds.) (1991) *Conservation of Medicinal Plants*. Cambridge University Press, Cambridge.

Farnsworth, N.R. and Bingel, A.S. (1977) Problems and prospects of discovering new drugs from higher plants by pharmacological screening. In: H. Wagner and P. Wolff (Eds.), *Medicinal Plant Research*. Springer Verlag, Berlin, pp. 1–22.

Farnsworth, N.R. and Morris, R.W. (1976) Higher plants — the sleeping giant of drug development. *American Journal of Pharmacy* 148, 46–52.

Farnsworth, N.R. and Soejarto, D.D. (1991) Global importance of medicinal plants. In: O. Akerele, V. Heywood and H. Synge (Eds.), *Conservation of Medicinal Plants*. Cambridge University Press, Cambridge, pp. 25–42.

Hedberg, I. (1987) Research on medicinal and poisonous plants in the tropics: past, present and future. In: A.J.M. Leeuwenberg (Compiler), *Medicinal and Poisonous Plants of the Tropics*. Pudoc, Wageningen, pp. 9–15.

House of Lords 1st Report, Session 1991–92, *Systematic Biology Research*, Vol. I. (HL Paper 22-I). HMSO, London.

Kokwaro, J.O. 1976. *Medicinal Plants of East Africa*. East African Literature Bureau, Nairobi.

Maheshwari, J.K. (1988) Ethnobotanical research and documentation. In: I. Hedberg (Ed.), Systematic Botany — a key science for tropical research and documentation. *Symbolae Botanicae Upsalienses* 28 (3), 207–217.

Mangelsdorf, P.C. (1972) Introduction. In: T. Swain (Ed.), *Plants in the Development of Modern Medicine*. Harvard University Press, Cambridge, MA.

Samuelsson, G. (1988) The need for systematic botany in research on plants used in traditional medicine. In: I. Hedberg (Ed.), Systematic botany — a key science for tropical research and documentation. *Symbolae Botanicae Upsaliensis* 28 (3), 186–188.

Samuelsson, G., Farah, M.H., Claeson, P., Hagos, M., Thulin, M., Hedberg, O., Warfa, A.M., Hassan, A.O., Elmi, A.H., Abdurahman, A.D., Elmi, A.S., Abdi, Y.A. and Alin, M.H. (1991) Inventory of plants used in traditional medicine in Somalia. I. Plants of the families Acanthaceae–Chenopodiaceae. *Journal of Ethnopharmacology* 35, 25–63.

Schultes, R.E. (1991) The reason for ethnobotanical conservation. In: O. Akerele, V. Heywood and H. Synge, (Eds.), *The Conservation of Medicinal Plants*. Cambridge University Press, Cambridge, pp. 65–75.

Spjut, R.W. and Perdue, R.E. (1978) Plant folklore: a tool for predicting sources of antitumour activities? *Cancer Treatment Reports* 60, 979–985.

Wachtel, P. (1991) Let's stop talking to ourselves: the need for public awareness. In: O. Akerele, V. Heywood, and H. Synge (Eds.), *Conservation of Medicinal Plants*. Cambridge University Press, Cambridge, pp. 273–280.