

Systematic botany and ethnobotany in our research programs

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Abstract

Based on research results in applied botany, the author gives an overview of the interaction between systematic botany and ethnobotany, and the valorization path of plants, supported by methodological approaches while leading field prospections and laboratory processing (herbarium and traceability). Recommendations on protection and exploitation of plant diversity, and local knowledge are emphasized.

Keywords: botany, ethnobotany, valorization.

Introduction

Although botany corresponds to all sciences studying the plants, the concerned persons by work on the plants first assimilate it to the systematic botany. It is a composite discipline in constant evolution, interacting with its sub-disciplines (physiology, biochemistry, ecology, chemistry ...) and concerns a range of applications (environment, agriculture, industry, pharmacy ...). Practiced since 1895, the ethnobotany covers the knowledge of local people and their relationships with plants.¹ Ethnobotany involves panoply of micro-disciplines such as ethno-mycology, ethnopharmacology, ethnomedicine, ethnoecology, anthropology of health...².

In North Africa, early research in the domain of the applied botany have been ordered by the colonial administration, in order to inventory the useful flora, to know local practices and/or to mobilize all resources of the countries colonized.

¹ Wong J.L.G., Thornber K., Baker N. 2001: *Evaluation des ressources en produits forestiers non ligneux. Expérience et principes de biométrie*. Produits forestiers non ligneux, FAO, Rome, 13, pp. 63-69.

² Bellakhdar J. 2008: *Hommes et plantes au Maghreb. Eléments pour une méthode en ethnobotanique*. Editions / Diffusion Lulu.com & Lefenec.com.

Studies claiming a truly ethnobotanical approach began after the independence of the Maghreb countries to safeguard national cultural heritage, and non-guided by a utilitarian orientation.³.

The development of ethnobotanical studies is *sine qua non*, especially for the cultures not having undergone any abrupt changes lately, insofar as we attend a simultaneous change of the traditional knowledge and the plant diversity⁴. This appeal by countless authors is essentially to document these traditional oral knowledge on the one hand and to identify local plant diversity, often unrecognized, secondly, for serving among others for the purpose of research and development in the immediate or in the future. If these ethnobotanical studies often have territorial scope, others are limited to plant species data, or oriented toward utilitarian categories of plants or toward socioeconomic and environmental applications⁵.

³ Bellakhdar J. 2008: Ibid.

⁴ Ennabili A., Gharnit N., El Hamdouni E.M. 2000: *Inventory and social interest of medicinal, aromatic and honey-plants from Mokrisset (NW of Morocco)*. Stud. Bot., 19 pp. 57-74. Rivera Núñez D., C. Obón de Castro. 2002: *El contexto etnobotánico mediterráneo y la fitoterapia*. Revista de Fitoterapia, 2(1) pp. 47-55. Morales R., Tardío J., Aceituno L., Molina M., Pardo de Santayana M. 2011: *Biodiversidad y Etnobotánica en España*. Memorias R. Soc. Esp. Hist. Nat., 2ª ép., 9, pp. 157-207. Quave C.L., Pardo-de-Santayana M., Pieroni A. 2012: *Medical Ethnobotany in Europe: From Field Ethnography to a More Culturally Sensitive Evidence-Based CAM?* Hindawi Publishing Corporation Evidence-Based Complementary and Alternative Medicine, ID 156846, 17 pages, doi:10.1155/2012/156846 [accessed July, 2014].

⁵ e.g. Ennabili A., Nabil L., Ater M. 1996: *Importance socio-économique des hygrophytes au Nord-ouest du Maroc*. Al Biruniya Rev. Mar. Pharm., 12(2): pp. 95-120. Ennabili et al. 2000: Ibid. Gharnit N., El Mtili N., Ennabili A.T., Ennabili A. 2001: *Social characterisation and exploitation of carob tree (Ceratonia siliqua L.) from Mokrisset and Bab Taza (NW of Morocco)*. Science Letters, 3(2), 10 p. Gharnit N., El Mtili N., Toubi Ennabili A., Ennabili A. 2003: *Exploitation du caroubier (Ceratonia siliqua L.) dans la Commune d'Aïn Beïda, Province de Chefchaouen*. In A. Boukroute (Ed.), *Arbres et espaces verts urbains, du chercheur au gestionnaire*, Actes Editions, Rabat, pp. 93-100. Libiad M., Khabbach A., Ennabili A. 2014: *Phytodiversité et gestion des eaux de surface. Cas du bassin versant de l'oued Inaouène et environs (Nord-ouest du Maroc)*. Editions universitaires européennes, Sarrebruck, Allemagne, 215 p.

This paper tries to highlight the place given to systematic botany and ethnobotany in actions of Scientific Research (funded programs, research routine, training...) involving the National Institute of Medicinal and Aromatic plants, Morocco, created in 2002 and put into operation a few years later.

Context

Whether in the context of international projects, national research programs, actions of the University or personal initiatives, the applied botany is limited generally to a simple identification of plant samples, subject of study, far from the species features (structure, morphogenetic, physiology, autecology, inherent traditional knowledge ...).

Plant samples to identify are generally taken from one or more genotypes by the concerned person, not necessarily a taxonomist botanist, searched through intermediaries and / or purchased from herbalists. Field prospections in *good and due form* are not often of custom in this type of research.

However, other actions do not resort to the traditional Moroccan pharmacopoeia, and conduct a national systematic-screening of plant species. Moreover, most research led in this optics are generally oriented toward diseases with a high incidence in developed countries⁶, requiring in addition huge means, out of reach for most countries of the South.

Considering the lack of coordination between the different actors interested in applied botany and ethnobotany on the one hand, and inadequate and sometimes under-utilization of available resources on the other hand, we are witnessing a proliferation of studies unfortunately unable to bridge the strange gap between public expectations and socio-professional, and the world of scientific research in this regard.

⁶ Chominot A. 2000: *Valorisation des plantes médicinales par l'industrie pharmaceutique, complémentarités et contradictions*. Courier de l'environnement de l'INRA, 39 pp. 19-26.

Field prospections

The coupling between the natural ecosystem and socio-system is so important that the Mixtec, for example, consider the maize as an anthropomorphic plant, endowed with a soul, whose parts are described like a human body and of which the cycle of growth is analogous to the cycle of the human life⁷. This interaction between cultural diversity and plant diversity requires an interdisciplinarity, characterizing a fortiori the ethnobotany.

During these last decades, an increasing interest marks the relation between traditional knowledge and the ecosystems management⁸. The botanical knowledge takes the learning about life and the need. For a farmer, to know a plant is first of all to learn to manage a resource, contrary to what can be observed in the city, which develops a phenomenon of unlearning⁹. In addition, younger generations are generally no longer able to identify local flora having a direct utility as wild food or care sources¹⁰.

Methodological approaches for the vegetation study do not lack on quality (taxonomic inventory, sociability, vitality, structure, bio-typology, habitat, seasonality ...) ¹¹ and quantity

⁷ Katz E. 2005: Plante, corps et cosmos: le cycle agricole du maïs en pays mixtèque (Mexique). Société suisse des Américanistes / Schweizerische Amerikanisten-Gesellschaft Bulletin 69, pp. 39-49.

⁸ Calvet-Mir L., Calvet-Mir M., Reyes-García V. 2010: *Traditional ecological knowledge and landraces in situ conservation in high mountain homegardens of Vallflosca, Catalan Pyrenees, Iberian Peninsula*. In "María Lelia Pochettino, Ana H. Ladio, Patricia M. Arenas (Ed.), *Tradiciones & transformaciones en Etnobotánica*. CYTED - Programa Iberoamericano Ciencia y Tecnología para el Desarrollo, Argentina, pp. 457-464. Cf. Bahuchet S. 2012: *Du Jatba - Revue d'ethnobiologie à la Revue d'ethnoécologie*. *Revue d'ethnoécologie*, <http://ethnoecologie.revues.org/689> [accessed June, 2014].

⁹ Bellakhdar J. 1991: *Les sciences de la nature et la botanique médicale chez les arabes*. Al Biruniya Rev. Mar. Pharm., 7(2) pp. 87-111.

¹⁰ Quave et al. 2012: Ibid.

¹¹ 1996. Ennabili A, Ater M - Flore (Pteridophyta et Spermatophyta) des zones humides du Maroc méditerranéen : Inventaire et Ecologie. *Acta Botanica Malacitana* 21 : 221-239.

(abundance, dominance, density, vegetation cover, productivity, diversity ...) ¹². In addition, the value of plant diversity could in no way be reduced to the direct use of the resource, but its functional values (landscape, flood control, biodiversity conservation, recreation...) should be evaluated within the ecosystem ¹³.

Depending on the purpose and scope of the study, ethnobotanical and / or socio-economic questionnaires-forms are established taking into account particularly the human and cultural factors (size and structure of the population to be interviewed, vernacular nomenclature, practices and designs related to the plants, historical facts, informal economy, statistics, literature ...) ¹⁴.

2003. Ennabili A, Gharnit N - Checklist and diversity of wetland flora (*Pteridophyta* and *Spermatophyta*) from the Mediterranean Morocco. *Lagascalia* 23: 7-25.

¹² 1998. Ennabili A, Ater M, Radoux M - Biomass production and NPK-retention in macrophytes from wetlands of the Tingitan Peninsula. *Aquatic Botany* 62(1): 45-56.

2000. Ennabili A, Ater M, Radoux M - Biomasse et Accumulation des NPK chez *Scirpus litoralis* Schrader et *Scirpus maritimus* L. aux marais Smir-Negro (NW du Maroc). *Acta Bot. Barc.* 46 : 239-250.

¹³ Wong et al. 2001: Ibid. Khabbach A., Libiad M., Ennabili A. 2014: *Valeurs et services de la phytodiversité. Cas de la flore vasculaire de la zone pré-Rifaine, Province de Taza (Nord-ouest du Maroc)*. Editions universitaires européennes, Sarrebruck, Allemagne, 200 p.

¹⁴ Ennabili et al. 1996, 2000: Ibid. Gharnit et al. 2001, 2003: Ibid. Ennabili A., Gharnit N., Maach Y., El Meskaoui A., Bousta D. 2006: *Exploitation des plantes médicinales et alimentaires du bassin versant de l'oued Laou (Nord-ouest du Maroc)*. J. Bot. Soc. Bot. France, 36 pp.71-79. Gharnit N., El Mtili N., Ennabili A., Sayah F. 2006: *Importance socio-économique du caroubier (Ceratonia siliqua L.) dans la Province de Chefchaouen (Nord-ouest du Maroc)*. J. Bot. Soc. Bot. France, 33 pp. 43-48. El Mansouri L., Ennabili A., Bousta D. 2011: *Socioeconomic interest and valorization of medicinal plants from the Rissani oasis (SE of Morocco)*. Bol Latinoam Caribe Plant Med Aromat, 10(1) pp. 30-45. Khabbach A., Libiad M., Ennabili A. 2011: *Plant Resources Use in the Province of Taza (North of Morocco)*. ProEnvironment, 4(8) pp. 347-356. Libiad M., Khabbach A., Ennabili A. 2011: *Exploitation of plants from upstream of the Sebou-wadi watershed (province of Taounate, North of Morocco)*. Biological Diversity and Conservation, 4(2) pp. 81-91. Khabbach A., Libiad M., Ennabili A. 2012: *Production et commercialisation des ressources végétales dans la province de Taza (Nord du Maroc)*. Revue AFN Maroc, 6-8 pp.64-83. Khabbach A., Libiad M., Ennabili A., Bousta D. 2012: *Medicinal and*

Nevertheless, some precautions are to take in consideration in this regard, and avoid the hasty analyses of the collected data: subjective quantification, size of the population interviewed, repetition of the collection, level of instruction of the interviewees, objectivity of the observer, interpretation of traditional words...¹⁵.

Herbarium

For all studies on plants, reference samples, i.e. representative plant-specimens, should be properly stored in an official herbarium. Every user of the studies led would have the possibility then to verify the used plant material objectively, and if necessary, to reproduce the work.

This task requires obviously a team of specialists and technicians, and material resources, beyond what is currently accessible. Using plants-identification keys available, often incomplete and / or outdated, a representative plant material is required in multiple examples. Additional data are expected to sustain and diversify the use of the identified plants: taxon descriptors, distribution, sampling location, traditional use and anthropization... Once programmed, botanical surveys prospections allow adequate sampling and recognition of plant material, and marking stations and / or genotypes prospected.

However, we often receive in the laboratory plant material to identify, and recognition forms are made indicating the application [framework applicant and type of material delivered] and given service [identifier name and classification of the plant taxon in question]. The origin of the plant material (researchers, herbalists, associations, traders, industrialists ...) is problematic in this regard, and of course lack of scientific and professional rigor. This procedure would only devalue the

cosmetic use of plants from the province of Taza, Northern Morocco. Bol Latinoam Caribe Plant Med Aromat, 11(1) pp. 46-60. Khabbach A., Libiad M., Ennabili A. 2013: *Melliferous flora and apiculture in the pre-Rif of the Province of Taza (North of Morocco)*. Luna Azúl, 36 pp. 78-90.

¹⁵ e.g. De Foucault B., Claisse R. 1995: *Sur quelques noms vernaculaires de plantes de la pharmacopée traditionnelle marocaine (Région de Rabat-Salé)*. Al Biruniya Rev. Mar. Pharm., 11(1) pp. 59-64. Ennabili et al. 1996: Ibid. Wong et al. 2001: Ibid.

studies led, insofar as samples and / or additional information about the plant material are rarely disclosed by the applicant for this service.

In all cases, a botanical code is assigned to each exsiccata, or voucher of the identified plant. This corresponding code should accompany every study on the plant material on the one hand and its valorization path on the other plant. It serves as a guide for future audit (systematic revisers, users of the studies carried out on the plant, new field prospections and studies...).

Traceability

While consulting various publications, the botanical data (localization and research of the plant in the field, herbarium data, particular observations...) is differently reported. In addition to the works that fully keep the communicated information and, therefore, don't lend any confusion in case of verification and/or use of works achieved¹⁶, it should be noted objectively some cases of figures, without prejudice to a work or another.

The field prospection (localization, sampling, identification...) is "contracted" in a simple identification of the plant material

¹⁶ Ben Hammou F., Skali S.N., Idaomar M., Abrini J. 2011: The antimicrobial effect of *Origanum compactum* essential oil, nisin and their combination against *Escherichia coli* in tryptic soy broth (TSB) and in sheep natural sausage casings during storage at 25 and 7°C. African Journal of Biotechnology, 10(71) pp.15998-16005. El Ouarti A., Hassi M., Sqalli H., Aarab L., Ennabili A., Houari A., Haggoud A., Ibnsouda S., Iraqui M. 2011: *Activité antimycobactérienne extra et intracellulaire de l'écorce des racines de Berberis hispanica*. Bull. Soc. Pharm. Bordeaux, 149 pp. 67-84. El Hajaji H., Farah A., Ennabili A., Bousta D., Greche H., El Bali B., Lachkar M. 2013: *Etude comparative de la composition minérale des constituants de trois catégories de Ceratonia siliqua L. (Comparative study of the mineral composition of the constituents of three varieties of Ceratonia siliqua L.)*. J. Mater. Environ. Sci., 4(2) pp. 165-170. Elkhamlichi A., El Antri A., El Hajaji H., El Bali B., Oulyadi H., Lachkar M. 2014 : *Phytochemical constituents from the seeds of Calycotome villosa subsp. Intermedia*. Arabian Journal of Chemistry, In Press. El Mansouri L., Bousta D., Boukhira S., Balouiri M., El Khanchoufi A., Akdime H., Bennani B., Achour S. 2014. *Phytochemical screening and anti-inflammatory property of one recipe from moroccan traditional medicine*. International Journal of Phytopharmacology, 5(2) pp. 76-84.

without or with signaling of the exsiccata code¹⁷. Authors don't transmit the communicated reserves while recognizing an incomplete plant material, and as a result, doubtfully identified¹⁸, or omit the identifier¹⁹, although the exsiccata code has been reported.

Others increase one-sidedly the number of taxa included in the survey, and attribute their identification mistakenly to the

¹⁷ Boudkhili M., Greche H., Bouhdid S., Zerargui F., Aarab L. 2012: *In vitro* antioxidant and antimicrobial properties of some Moroccan's Medicinal plants. Int. J. PharmTech Res., 4(2) pp. 637-642. Berrada H., Farah A., Fadil M., Fikri Benbrahim K. 2013. *Anti-bacterial activity of Coriaria myrtifolia against Agrobacterium tumefaciens: Plant pathogen responsible for crown gall*. African Journal of Microbiology Research, 7(48) pp. 5529-5532. Bousta D., Farah A., Elyoubi-El Hamsas A., El Mansouri L., Soidrou S.H., Benjilali J., Adadi I., Greche H., Lachkar M., Alaoui Mhamdi M. 2013: *Phytochemical screening, antidepressant and immunomodulatory effects of aqueous extract of Cistus ladanifer L. from Morocco*. International Journal of Phytopharmacology, 4(1) pp. 12-17. Nouioui I., Sbissi I., Ghodhbane-Gtari F., Fikri Benbrahim K., Normand P., Gtari M. 2013. *First report on the occurrence of the uncultivated cluster 2 Frankia microsymbionts in soil outside the native actinorhizal host range area*. J. Biosci. 38(4), pp. 695–698. Boudkhili M., Meddah B., Ait El Cadi M., Greche H., Aarab L. 2014: *Effect of Coriaria myrtifolia extract on the depression in Mice*. International Journal of Pharmacological Screening Methods, 4(1) pp. 4-8. Nouioui I., Ghodhbane-Gtari F., Fernandez M-P., Boudabous A., Normand P., Gtari M. 2014: *Absence of Cospeciation between the Uncultured Frankia Microsymbionts and the Disjunct Actinorhizal Coriaria Species*. BioMed Research International, <http://dx.doi.org/10.1155/2014/924235> [accessed September, 2014]

¹⁸ e.g. Nordine A., Bousta D., El Khanchoufi A., El Meskaoui A. 2013: *An efficient and rapid in vitro propagation system of Thymus hyemalis Lange, a wild medicinal and aromatic plant of mediterranean region*. International Journal of Pharma Bioscience and Technology, 1(3): 118-129.

¹⁹ e.g. Hezbri K., Hafse M., Farah A., Sbissi I., Gtari M., Fikri Benbrahim K. 2014: *Antibacterial Activity of Lyophilized Aqueous Extract of Coriaria myrtifolia from Northern Morocco*. Journal of Advances in Biotechnology, 3(3) pp. 280-285. Nordine A., Hmamouchi M., El Meskaoui A. 2014: *In vitro clonal propagation through direct shoot organogenesis of Thymus broussonetii – a vulnerable aromatic and medicinal plant species*. International Journal of Pharmaceutical Research and Bio-Science, 3(1) pp. 425-439.

botanist taxonomist²⁰. Many other published works are omitting the origin and / or recognition of plant material.²¹

It should also be noted that a number of actions are carried out independently of traceability, whether in the context of international projects, national programs, doctoral researches, graduation memories and / or personal initiatives: territories screening, provision in known plant material...

However, the question of the genes detention arises as soon as the industry has resort to the living as raw material or like molecular-model to found its research. This action is the subject of an unresolved contradiction with regard to intellectual property. The taking out a patent on the plant material comes back to establish a property right on a free resource, while ignoring the prerogatives of the populations that had developed the knowledge and know-how²².

Final Considerations

Economic valorization of medicinal plants may appear in the guise of a polarity between traditional uses, an integral part of the local cultures, and sources of active principals and raw materials for the big pharmaceutical industry²³. But, several bioprospection projects have been reclassified like "scientific projects", seen the lack of commercial perspectives²⁴.

²⁰ e.g. Boukhira S., El Mansouri L., Bousta D. 2013: *Ethnobotanical studies of some medicinal and cosmetic plants used in the province of Sefrou, Middle Atlas of Morocco*. The Journal of Ethnobiology and Traditional Medicine. Photon, 120 pp. 661-670.

²¹ e.g. Jbilou R., Ennabili A., Sayah F. 2006: *Insecticidal activity of four medicinal plant extracts against Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae)*. African Journal of Biotechnology 5(10): 936-940. Boudkhili M., Greche H., Bouhdid S., Zerargui F., Aarab L. 2012: *Antioxidant and antimicrobial activities of some Moroccan's Plants*. Proceeding of the second edition of the international Congress : "Microbial Biotechnology for Development" (MICROBIOD 2), Marrakech, 02-04 Octobre 2012, pp. 204-205.

²² Chominot 2000: Ibid.

²³ Chominot 2000: Ibid.

²⁴ Filoche G., Foyer J. 2011: *La bioprospección en Brasil y México, ¿un nuevo Dora do?: entre la inestabilidad de las prácticas y la permanencia de las representaciones*. Mundo Amazónico, 2 pp. 17-42.

Research on plants in view of their valorization and conservation remain well evidently greatly dependent on the applied botany and particularly the ethnobotany. Nevertheless, we must mark works so-called on "plant valorization" consisting of a simple application of techniques that a researcher knows how to make, generally classified as scientific research on the one hand and scientific research applied to development prospects well defined on the other hand.

Besides, the objectives of plants research should be based on national priorities, in accordance with the regional and international cooperation. The flora endemism from Morocco²⁵ is one of the opportunities in this regard. On the cultural front, the Arab-Muslim dimension without ignoring other ethnic groups and/or confessions ones should be considered²⁶. The plant-endemism targeting not devalues on no account the national flora insofar as any plant is useful and potentially valuable. We could always list what plants do, but we would not know what they have.

The conservation of biodiversity and cultural diversity, or double conservation, should constitute a common task for the researchers and the political decision-makers, in close collaboration with the local populations²⁷. The implementation of mechanism to compensate the local people to use their knowledge of natural resources is required more than ever²⁸, although the legal recognition of knowledge is another problem in the law of intellectual property²⁹.

²⁵ Fennane M., Ibn Tattou M. 1998. *Catalogue des plantes vasculaires rares, menacées ou endémiques du Maroc*. Boccone, 8 pp. 5-243.

²⁶ Bellakhdar 1991: Ibid. Oueida F. 2002: *Médecine arabe et ethnopharmacologie : les plantes du Coran*. In J. Fleurentin, J-M. Pelt & G. Mazars (Ed. scientifiques), *Des sources du savoir aux médicaments du futur*, IRD Éditions, Paris, pp. 327-330.

²⁷ Dumoulin Kervran D. 2007: *Grandeur et décadence de la double conservation dans les arènes internationales*. Quaderni Université Paris 1, 64 pp. 23-36. Calvet-Mir et al. 2010: Ibid.

²⁸ Rivera Núñez et al. 2002: Ibid. Morales et al. 2011: Ibid.

²⁹ Bahuchet 2012: Ibid.

The access to biological resources and their exploitation remain sensitive regarding the national sovereignty and the defense of bio-cultural heritage³⁰. Given the international context, it is necessary to upgrade and diversify the national legal arsenal in order to protect the flora and control its byproducts. To date, it is not obvious to find satisfactory institutional solutions in the international agreements in effect and usually attends contracts between firms and organizations "representing" the owners of the resource³¹.

³⁰ Filoche & Foyer 2011: *Ibid.*

³¹ Chominot 2000: *Ibid.*