

# Ethnopharmacology: Design of an Undergraduate Course<sup>1</sup>

Stephen G. Gillespie

*School of Pharmacy, University of Wyoming, Laramie, WY 82071*

The purpose of this paper is to describe a design for a course in ethnopharmacology offered through a pharmacy school. The course was developed in response to the growing public interest in medicinal plants and alternative medicine and is intended to foster global-oriented thinking and multiculturalism from the perspective of medicinal plants. The general objectives of the course are to introduce students to the history, demographics, and cultural context of medicinal plant use, field and laboratory methods in ethnopharmacology, conservation and ethical issues, and alternative medicine. Problems selecting course content and readings are discussed. An extensive reading list is provided. Student evaluations have been positive.

## INTRODUCTION

The subject of pharmacognosy has been curtailed or even removed from the curricula in pharmaceutical education in some western countries(1). This decline may parallel the downward trend in prescribing medicinal plants and the very small percentage of newly approved drugs derived from higher plants. In contrast, public interest in medicinal plants is growing(2) and the use of alternative medicine in the United States is widespread(3).

Interest in plant-based drug discovery and development programs in this country waned continuously through the 1960s, 1970s, and early 1980s(4). However/with the advent of automated, high-throughput screening methods(5), the pharmaceutical industry has demonstrated a renewed, commitment to searching for new medicinal agents from higher plants(6). Ethnobotanical input has influenced this movement(7) and is the chief strategy of development for at least one new pharmaceutical company(8).

Ethnopharmacology may be defined as a multidisciplinary study of biologically active agents used in traditional medicine. Traditional medicine is a term applied to pre-scientific medical systems that possess bodies of medical knowledge, including pharmacopoeia, that are passed through generations from healer to healer. The professional traditional medical systems of Ayurvedic, Chinese, and Galenic, as well as nonprofessional traditional systems of smaller, indigenous cultures are included in this purview. Unorthodox therapies such as chiropractic, homeopathy, and herbal folk medicine used in the industrialized societies of North America and Europe are not systems of traditional medicine and are more frequently termed alternative medicine(9).

<sup>1</sup>This paper has been adapted from a workshop presented at "Pharmacy from the Rainforest: An Amazon Rainforest Workshop", sponsored by the American Botanical Council and the Texas Pharmacy Foundation, located at the Explorama Lodge and the Amazon Center for Environmental Education and Research, Peruvian Amazon near Iquitos, 23 October 1994.

Many disciplines and subdisciplines contribute to ethnopharmacology, including the natural sciences of botany, chemistry, pharmacology, and medicine. The social sciences and humanities contribute data to ethnopharmacology from the fields of cultural anthropology, sociology, archeology, and history.

Ethnopharmacology and pharmacognosy overlap considerably, but can be differentiated by several distinct features(10). Pharmacognosy considers a broad range of natural products used as therapeutic agents, for medical purposes (such as cotton), as pharmaceutical aids, biologics, and as poisons; ethnopharmacology is restricted to natural products used in a traditional context. Pharmacognosy is concerned with the history, economics, and commercial processing of natural substances that affect human health; ethnopharmacology seeks to provide a comprehensive view of the human use of crudely processed drugs that includes ethnographic information. Pharmacognosy has tended to move toward specialized fields such as biosynthesis and fermentation microbiology; ethnopharmacology aims to support interdisciplinary collaboration.

The purpose of this paper is to describe a design for a course in ethnopharmacology offered through a pharmacy school. The course described is not advocated to replace pharmacognosy or the elements of pharmacognosy that have been incorporated into medicinal chemistry courses. The course is intended to foster global-oriented thinking and multiculturalism from the perspective of medicinal plants.

## COURSE DESCRIPTION

Ethnopharmacology is a three semester hour course developed by the author. At the University of Wyoming ethnopharmacology is offered as an elective to all majors. The course is at the junior/senior level, requires general biology as a prerequisite, and is limited to twenty students.

The intended audience for the course is the university-wide community. Prerequisites (such as organic chemistry, biochemistry, and physiology) that would aid understanding of technical pharmacology have not been considered appropriate, as the purpose of the course is not to train professionals. Such prerequisites would also restrict the majors and probably the number of students enrolling. By minimizing prerequisites and allowing all majors, students from advertising, art, biology, botany, nutrition, pharmacy, and zoology have enrolled so far, although most students have been pharmacy or pre-pharmacy majors.

Since the course is designed for students from many different academic backgrounds, pharmacology and chemistry content is descriptive. Similarly, social science concepts discussed in the course do not require students to possess a theoretical background in anthropology or sociology.

### COURSE GOALS

The primary goal of the course is to stimulate a global perspective with respect to medicinal plants. Indeed, the great ethnobotanist Richard Evans Schultes states "the history of civilization could be written in terms of economic plants"(11). The two faces of a global perspective are cultural and biomedical. To present the comprehensive view that ethnopharmacology represents, specific objectives of the course currently taught at the University of Wyoming are listed in Table I. A discussion of aspects of course design follows.

### COURSE DESIGN OPTIONS

Ethnopharmacology encompasses a broad range of disciplines, producing both advantages and disadvantages for the instructor. One advantage is the flexibility in choosing course content. Instructors may choose to concentrate on the history and development of specific medicinal plants, such as *Papaver somniferum* (opium poppy), *Digitalis lanata* (foxglove), *Catharanthus roseus* (Madagascar periwinkle), *Cinchona ledgeriana* Moens ex Trimen (yellow cinchona), and other important plants in western medicine. A vast body of literature exists to supplement such an approach. Alternatively, instructors may wish to concentrate on medicinal plants primarily used in traditional cultures or on plant-based compounds of current research interest such as prostratin, an anti-HIV lead from *Homalanthus nutans*, or artemisinin, an antimalarial from *Artemisia annua*. Instructors could also emphasize the cultural basis of medicinal plant use in traditional societies. The literature of medical anthropology and sociology offers ample opportunity for development of a bibliography in the area of ethnopharmacology.

Selecting readings from the vast literature of ethnopharmacology to achieve course goals presents the instructor with the greatest challenge. It is therefore imperative that the instructor carefully establish goals. The author has designed a course intended to survey the broad subject matter. Examination of the topics and readings in Appendix A reveals that biomedical and cultural aspects are accorded equal weight. Ethical and conservation issues are also important. The author has avoided compilations that typically document taxonomic identification and local names, symptoms that a medicine is used to treat, plant part and preparation, chemical constituents, and pharmacological activities.

## Table I. Course objectives

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### Upon completion, the student should be able to:

1. Define ethnopharmacology and become familiar with the breadth of approaches to the subject.
  2. Delineate the history and demographics of medicinal plant drug use in traditional human societies.
  3. Identify plant-based drugs utilized in western medicine that originated in traditional medicine.
  4. Describe and compare systems of professional and nonprofessional traditional medicine.
  5. Outline selected systems of traditional medicine, theories of disease causation, and aspects of ethnic pharmacopoeias.
  6. Discuss the methods and rationales used by traditional healers.
  7. Discuss theories of chemical ecology as related to human diet and medicine.
  8. Describe the fieldwork methods of ethnopharmacology, including ethnography and botany.
  9. Describe the laboratory methods of ethnopharmacology, including pharmacology and chemistry.
  10. Discuss the ethical issues surrounding the development of traditional medicinal plant drugs by western medicine.
  11. Discuss conservation efforts aimed at preservation of medicinal plants and biological diversity.
  12. Analyze the impact of acculturation on ethnopharmacology.
  13. Identify medicinal plants and compounds currently of interest or in development.
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### COURSE FORMAT

The course is taught primarily by a lecture format. An outline of topics and respective readings (Appendix A) provides a chronology for the course and a means of achieving the course objectives. Limited video material is utilized in the course (Appendix B). Although many films about medicinal plants have been produced, the availability and condition of these older, mainly 16 mm films preclude their use. Medicinal plant specimens from the pharmacognosy laboratory at the School of Pharmacy enhance classroom presentations. Demonstrations of laboratory techniques such as liquid extraction of plant material (employing a Soxhlet apparatus) and thin layer chromatography are also utilized. An herbarium on campus provides the opportunity to examine botanical voucher specimens.

The class size has been limited to encourage discussion. Grade determination is based on participation, two written, essay-type midterm examinations and a research paper. Topics for research papers are allowed a broad range, consistent with the scope of ethnopharmacology. Research papers allow the students to focus their interests and concentrate on one topic within the context of the broad, survey course described.

### COURSE EVALUATION AND FUTURE DIRECTIONS

Ethnopharmacology was first taught in summer 1994 as an university-wide, designated innovative summer session course and is being taught currently (Fall 1994). Informal classroom evaluation in Summer 1994 was accomplished simply by asking students at the beginning to give written answers to a question about what interests influenced them

to enroll for the course. Written responses to questions about what topics were most interesting and what topics they would like to add were also collected at the end of the course. Most answers to the first question indicated a general interest in medicinal plants, with specific interests in aspects of herbal vs. modern Pharmaceuticals and in medicinal plant identification and pharmacological screening. At the end of the course, students indicated that the theories and practices of traditional systems of medicine (such as Chinese medicine), methods of ethnopharmacology, and histories of specific medicinal plants (such as *Cinchona*) were most interesting. In general students did not suggest new topics for the course but stated that more detail about the topics considered would be desirable. Informal assessment at the beginning of the Fall 1994 class shows a similar range of interests to the Summer 1994 class, with alternative (herbal) medicine being the most common.

Formal evaluation of teaching by students is accomplished using a Likert-scaled questionnaire of 21 questions and open-ended comments. The most favorable response is 1.00 and 4.00 is the least favorable response. The overall mean in Summer 1994 was 1.43, indicating a very favorable response. Mean responses ranged from 1.11 (instructor demonstrated competency with subject matter: also course content includes recent advances in the field) to 1.89 (readings helped my understanding of this course).

With the results of students' evaluations in mind the author has modified the readings from Summer 1994 to include more detailed consideration of selected systems of traditional medicine [see readings (3) and (4) in topic III, Appendix A]. Also added for Fall 1994 is the topic of alternative medicine (see topic IX, Appendix A). The burgeoning interest in alternative medicine(3) warrants the inclusion of herbal medicine used in industrialized societies as a topic. In fact, the development of a separate course with the purpose of enabling practicing pharmacists to counsel patients on wise use of herbal medicines seems appropriate.

Fieldtrips to identify and collect local medicinal plants are a possibility for an ethnopharmacology course. The mountains near Laramie, Wyoming are habitat for a large number of medicinal plants used by native American cultures. During Summer 1994 the author conducted a field trip to the Laramie Mountains for the University of Wyoming High School Summer Institute. An ethnobotanical analyst for the Wyoming State Archeologist Office accompanied the class as a field guide. Student response to the field trip was quite enthusiastic.

The author has had a positive overall experience designing and teaching ethnopharmacology. Student response has been equally positive. Several benefits to pharmacy education and practice are evident. Pharmacy students are introduced to aspects of medicinal plants and natural products that have been disappearing from the curricula. Pharmacy students are also introduced to concepts that can help to explain the attitudes, beliefs, and behaviors of patients who use alternative medicine. Pharmacy students may also benefit from the presence of a diverse academic background of other students.

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- (4) Farnsworth, N.R., "Screening plants for new medicines," in *Biodiversity*, (edit. Wilson, E.O.) National Academy Press, Washington DC (1988) pp 83-97.
- (5) Hamilton, J. O'C., "Turbocharging the race for miracle drugs," *Bus. Week*, 92-93 (March 1, 1993).
- (6) Farnsworth, N.R., "Ethnopharmacology and future drug development: the North American experience," *J. Ethnopharm.*, **38**, 145-152 (1993).
- (7) Cox, P.A. and Balick, M.J., "The ethnobotanical approach to drug discovery," *Scientific American*, 82-87 (June 1994).
- (8) King, S.R., "Pharmaceutical discovery, ethnobotany, tropical forests, and reciprocity: integrating indigenous knowledge, conservation, and sustainable development," in *Sustainable Harvest and Marketing of Rain Forest Products*, (edits. Plotkin, M. and Famolare, L.) Island Press, Washington DC (1992) pp 231-238.
- (9) Wardwell, W.I., "Alternative medicine in the United States," *Sue. Sci. Med.* **38**, 1061-1068 (1994).
- (10) deSmet, P.A.G.M. and Rivier, L., "A general outlook on ethnopharmacology," *J. Ethnopharm.*, **25**, 127-138 (1989).
- (11) Plotkin, M.J., *Tales of a Shaman's Apprentice: An Ethnobotanist Searches for New Medicines in the Amazon Rain Forest*, Viking-Penguin, New York NY (1993) ix.

## APPENDIX A. TOPIC OUTLINE AND READINGS

### I. Introduction

- (1) Plotkin, M.J., *Tales of a Shaman's Apprentice: An Ethnobotanist Searches for New Medicines in the Amazon Rain Forest*, Viking-Penguin, New York NY (1993).
- (2) deSmet, P.A.G.M. and Rivier, L., "A general outlook on ethnopharmacology," *J. Ethnopharm.*, **25**, 127-138 (1989).
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- (4) Cox, P.A. and Balick, M.J., "The ethnobotanical approach to drug discovery," *Scientific American*, 82-87 (June 1994).
- (5) Roach, M., "Secrets of the Shamans", *Discover*, 58-65 (Nov. 1993).
- (6) Gentry, A.H., "Tropical forest biodiversity and the potential for new medicinal plants," in *Human Medicinal Agents from Plants*, (edits. Kinghorn, A.D. and Balandrin, M.F.) American Chemical Society, Washington DC (1993) pp. 13-24.
- (7) Emmett, A., "Where east does not meet west", *Technology Review*, 50-56 (Nov/Dec 1992).
- (8) Etkin, N.L., "Ethnopharmacology: biological and behavioral perspectives in the study of indigenous medicines," in *Medical Anthropology: A Handbook of Theory and Method*, (edits. Johnson, T.M. and Sargent, C.F.) Greenwood Press NY (1990) pp. 149-158.

### II. Human Chemical Ecology and the Origins of Medicine

- (1) Johns, T., *With Bitter Herbs They Shall Eat It*, The University of Arizona Press, Tuscon AZ (1990) xiii-xv.
- (2) Op. cit. (1), pp. 1-23.
- (3) Op. cit. (1), pp. 251-291.

### III. Traditional Medical Systems

- (1) Murdock, G.P., *Theories of Illness: A World Survey*, University of Pittsburgh Press, Pittsburgh PA (1980) pp. 3-27.
- (2) Vogel, H.G., "Similarities between various systems of traditional medicine. Considerations for the future of ethnopharmacology," *J. Ethnopharm.*, **35**, 179-190(1991).
- (3) Reid, D.P., *Chinese Herbal Medicine*, Shambala Publications, Boston MA (1987) pp. 26-77.
- (4) Cox, P.A., "Polynesian herbal medicine," in *Islands, Plants, and Polynesians*, (edits. Cox, P.A. and Banack, S.A.)

Dioscorides Press, Portland OR (1991) pp. 147-168.

- (5) Golomb, L., "The systematic nature of traditional curing," in *An Anthropology of Curing in Multiethnic Thailand*, University of Illinois Press, Urbana and Chicago IL, (1985) pp. 127-159.

#### IV. Contribution of Ethnopharmacology to Western Medicine

- (1) Holmstedt, B., "Historical perspective and future of ethnopharmacology," *J. Ethnopharm.*, **32**, 7-24 (1991).
- (2) Phillipson, J.D. and Anderson, L.A., "Ethnopharmacology and western medicine," *J. Ethnopharm.*, **25**, 61-72 (1989).
- (3) Kreig, M.B., *Green Medicine*, Rand McNally, Chicago II (1964) pp. 107-167.
- (4) Balandrin, M.F., Kinghorn, A.D. and Farnsworth, N.R., "Plant-derived natural products in drug discovery and development: An overview," in *Human Medicinal Agents from Plants*, (eds. Kinghorn, A.D. and Balandrin, M.F.) American Chemical Society, Washington DC (1993) pp. 2-12.

#### V. Methods in Ethnopharmacology

- (1) Waller, D.P., "Methods in ethnopharmacology," *J. Ethnopharm.*, **38**, 189-195 (1993).
- (2) Lipp, F.J., "Methods for ethnopharmacological field work," *J. Ethnopharm.*, **25**, 139-150 (1989).
- (3) Hedberg, I., "Botanical methods in ethnopharmacology and the need for conservation of medicinal plants," *J. Ethnopharm.*, **38**, 121-128 (1993).
- (4) Wickberg, B., "Chemical methods in ethnopharmacology," *J. Ethnopharm.*, **38**, 159-165 (1993).
- (5) Soejarto, D.D., "Logistics and politics in plant drug discovery," in *Human Medicinal Agents from Plants*, (eds. Kinghorn, A.D. and Balandrin, M.F.) American Chemical Society, Washington DC (1993) pp. 96-111.
- (6) Martin, G.J., "Searching for plants in peasant marketplaces," in *Sustainable Harvest and Marketing of Rain Forest Products*, (eds. Plotkin, M. and Famolare, L.) Island Press, Washington DC (1992) pp. 212-223.

#### VI. Integration of Traditional and Western Medicine

- (1) Golomb, L., "Traditional medicine's response to modern medicine," in *An Anthropology of Curing in Multiethnic Thailand*, University of Illinois Press, Urbana and Chicago IL, (1985) pp. 160-193.
- (2) Vehmirovic, B., "Is integration of traditional and western medicine really possible?," in *Anthropology and Primary Health Care*, (eds. Coreil, J. and Mull, J.D.) Westview Press, Boulder, CO (1990) pp. 51-78.
- (3) LeGrand, A., Sri-Ngernyung, L. and Streefland, P.H., "Enhancing appropriate drug use: The contribution of herbal medicine promotion," *Soc. Sri. Med.*, **32**, 549-552 (1991).

#### VII. Biodiversity and Conservation of Medicinal Plants

- (1) Akerele, O., "Medicinal plants: policies and priorities," in *Conservation of Medicinal Plants*, (eds. Akerele, O., Heywood, V. and Syngé, H.) Cambridge University Press, Cambridge MA (1991) pp. 341.
- (2) Schultes, R.E., "The reason for ethnobotanical conservation," in *Conservation of Medicinal Plants*, (eds. Akerele, O., Heywood, V. and Syngé, H.) Cambridge University Press, Cambridge MA (1991) pp. 65-75.
- (3) McNeely, J.A. and Thorsell, J.W., "Enhancing the role of protected area in conserving medicinal plants," in *Conservation of Medicinal Plants*, (eds. Akerele, O., Heywood, V. and Syngé, H.) Cambridge University Press, Cambridge MA (1991) pp. 199-212.
- (4) Huxtable, R.J., "The pharmacology of extinction," *J. Ethnopharm.*, **37**, 1-11 (1992).
- (5) Cox, P.A., "Saving the ethnopharmacological heritage of Samoa," *J. Ethnopharm.*, **38**, 181-188 (1992).

#### VIII. Ethical and Legal Issues in Ethnopharmacology

- (1) Elisabetsky, E., "Sociopolitical, economical and ethical issues in medicinal plant research," *J. Ethnopharm.*, **32**, 235-239 (1991).
- (2) Elisabetsky, E., "Folklore, tradition, or know-how?," *Cultural Survival Quarterly*, 9-13 (Summer 1991).
- (3) Blum, E., "Making biodiversity conservation profitable," *Environment*, **35**, 16-45 (1993).
- (4) King, S.R., "Pharmaceutical discovery, ethnobotany, tropical forests, and reciprocity: integrating indigenous knowledge, conservation, and sustainable development," in *Sustainable Harvest and Marketing of Rain Forest Products*, (eds. Plotkin, M. and Famolare, L.) Island Press, Washington DC (1992) pp. 231-238.

#### IX. Alternative Medicine

- (1) Tyler, V.E., "Phytomedicines in western Europe," in *Human Medicinal Agents from Plants*, (eds. Kinghorn, A.D. and Balandrin, M.F.) American Chemical Society, Washington DC (1993) pp. 25-37.
- (2) Eisenberg, D.M., Kessler, R.C., Foster, C, Norlock, F.E., Calkins, D.R. and Delbanco, T.L., "Unconventional medicine in the United States," *N. Engl. J. Med.*, **328**(4), 246-252 (1993).
- (3) Trachtman, P., "NIH looks at the implausible and the inexplicable," *Smithsonian*, 110-123 (Sept 1994).

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#### APPENDIX B. VIDEO TEACHING MATERIAL

- (1) *Jungle Pharmacy*, Cinema Guild (1989) 53 minutes.
- (2) *Secrets of the Rainforest*, National Geographic Explorer (9 April 1989) 25 minutes