

ISE Newsletter



April 2009, Volume 8, Issue 1



Dear ISE Members and Readers of our Newsletter

Sadly, this special issue of the ISE Newsletter is dedicated to the memory of Prof. Nina Etkin, Hawai'i. On January 27, 2009 she passed away at the still very young age of 60 years after a long battle with cancer. Nina has been very important to our Society's development and instrumental in strengthening our dialogue on biocultural research in ethnopharmacology. Of course she has also left an important mark in the broader development of ethnopharmacology. This ISE newsletter is dedicated to Nina, her life and scholarly achievements.

We have asked her partner, her friends, colleagues, former PhD students and ISE Board members to contribute a personal or more scholarly recollection. Wonderful stories, personal accounts, scholarly analyses and confessions illuminate her life and work showing a most impressive person and friend.

We are very sad to have lost a warm-hearted friend, an excellent adviser and a genius scientist. Nevertheless, we are all very happy that we had the opportunity to meet Nina personally or through her academic work, to have been influenced by her ideas. We are all convinced that her studies will continue to influence the community of ethnopharmacologists, which will hopefully continue to develop and grow.

Just a few years ago when we were still writing letters (and not only emails), a letter from Nina always contained some pressed flowers, very often bougainvilleas. This message in a message from a friend and colleague had a lasting impact on many. We hope that the recollections of friends and colleagues assembled here may serve as a bouquet of flowers celebrating her life and achievements.

With our best regards,

Barbara Frei Haller and Michael Heinrich
Editor and Co-Editor, ISE Newsletter

Obituary

Nina L. Etkin, June 13, 1948 - January 27, 2009

Nina L. Etkin, 60, Professor of Anthropology at the University of Hawai'i, died in Honolulu, on January 27, 2009, of cancer. Nina was born in New York City, earned the BA in Zoology at Indiana University, and began graduate studies in Anthropology in 1970 at Washington University-St. Louis, where she received the MA in 1972 and the PhD in 1975.

Her early research emphasized the biocultural dimensions of health, beginning with her Ph.D. dissertation, which explains the biochemical basis of protection against malaria infection that is afforded by an inherited enzyme (G6PD) deficiency. She also explored the evolution of population variability, epidemiology, and health through studies of sickle haemoglobin and malaria; ABO blood groups and infectious diseases; and the intersection of diet, genetics, and daily activity patterns in the expression of hypertension.

Her postdoctoral research evolved into a multi-decade study of Hausa health, diet, and medicine in northern Nigeria, through which she broadened her theoretical perspective to work at the interface of biology and culture. Her husband, Paul Ross, was an integral element of her Hausa research. She is best known for her pioneering work on the pharmacologic implications of plant use, especially the interrelations between medicine and food, and the cultural constructions of health and physiologic implications of people's health-seeking actions. In a later trajectory of

ethnomedical inquiry Nina began research on the use of complementary and alternative medicines (CAM) in Hawai'i. Her studies revealed that the uses of CAM are not only for preventive and therapeutic actions, but also are statements about what it means to be sick and who has access to the knowledge and substance of cure.



In sum, Nina's biocultural medical anthropology research raised questions about explanatory disease models and healing paradigms, 'irrational' drug use, agency and authority in identifying drug actions as primary or side effects, the overlap of medicine and food, physiological outcomes of self- and specialist-care, physician-driven and patient-augmented polypharmacy, syncretic models of health care, gauging therapeutic efficacy, and the cultural construction and social negotiation of medical knowledge.

Beginning early in her career, Nina has published extensively across a range of

disciplines. Her most recent book is *Edible Medicines: An Ethnopharmacology of Food* (2006). At the time of her death another book was in production, *Biocultural Perspectives on Food, and Beverages, and Association* and another in process, *An Ethnobiology of Darwin's Gardens*. Her research has been funded by the National Science Foundation, National Institutes of Health, Social Science Research Council, National Endowment for the Humanities, Fulbright, American Heart Association, National Geographic Society, and several private foundations and university sources.

Nina Etkin's first academic position was at the University of Memphis (1977-1979). She joined the Anthropology faculty at the University of Minnesota in 1979, and the University of Hawai'i in 1990. At UH, she served for many years as Graduate Chair and briefly as Department Chair, with strong contributions to college and university governance. She chaired dozens of anthropology PhD and MA committees, mentored extensively outside of anthropology, and served as external reviewer at both the graduate and faculty levels. Her CV lists about 130 publications, including 28 (three of them books) since she became ill about 4 years ago. Her accomplishments were recognized through the prestigious Regents' Award for Excellence in Research, and college teaching and merit awards. She had only recently learned that she was to be awarded the Distinguished Economic Botanist award at the Society for Economic Botany meetings in June, 2009, in Charleston,

SC, USA, at which occasion the Society will celebrate her life and career.

Among her many colleagues she will also be remembered because of her great dedication to scholarly work, her enthusiasm for critical dialogue and her quiet but determined personality. Her research greatly improved our understanding of how people understand and use what we commonly call medicine and food: *Food as medicine and medicine as food*. Nina travelled extensively, many of the trips centering on invitations to present plenary addresses and serving on the scientific boards of international conferences. She was a Fellow of the Linnean Society of London and past President of the International Society for Ethnopharmacology. She was editor-in-chief of one academic journal, associate editor of 3 others, and served on the editorial boards of another ten.

Outside of her professional accomplishments, Nina was passionate about hiking, botanizing, and pet dogs. She is survived by her husband and research partner, Paul Ross; three sisters, a niece, two nephews, and their families; and a golden retriever.

Donations may be directed to the American Civil Liberties Union (ACLU) or to the Nina L. Etkin Memorial Fund, which has been established to support graduate students: <http://www.anthropology.hawaii.edu/News/Announcements/2009/Etkin/index.html>

*by Nina Etkin,
lightly edited by Elaine Elisabetsky,
Michael Heinrich, and Dan Moerman*

.... There is grandeur in this
view of life.....

Like any creative artist, Nina Etkin recognized no boundaries between what she did and who she was. She was a full-time scholar – always learning, exploring, instructing -- punctuating her conversations with "Did you know?" or "Isn't that interesting?" or frequently breaking stride to scribble kernels of ideas in a notebook that was never far away. She marvelled at the nuances of language and the intricacies of science, always looking for order, reorder, association, and pattern.

She was never at ease with the boundaries of academic disciplines and got fidgety when faced with routine and comfort. For her, there was little leisure, only the constant joy of doing what she loved. She was reserved and diffident and yet quietly confident. As a public person, Nina was self-deprecating and modest but when alone and private, she "knew what she knew." She was always uncomfortable with the ebb and flow of social gatherings but gained vitality from heartfelt discussion, especially when centred on novel assaults to "the establishment", academic or otherwise. She disliked the formal and indiscriminate exercise of classroom teaching, but enthusiastically mentored those who demonstrated commitment and focus. Always sparing with her compliments, Nina was never more pleased than when her students succeeded. She was earnest -- even reverent -- about her calling but could not talk about what she did without drawing on a dry, deadpan, or even sardonic wit.

A terminal diagnosis five years ago was not a signal for her to slow down but a call to accelerate. With the end near, she was a whirlwind: finishing a book, cleaning up and organizing her files, cataloguing her

library, enthusiastically rekindling a love for the writings of Darwin, administering and advocating as her department's Graduate Chair, taking her beloved golden retriever for his daily walk, keeping her Vitae always current, and, yes, writing her own obituary. She loved her life and died too soon. She was my best friend for nearly 40 years and not nearly long enough.



Finally, a colleague reminded me of these words of Darwin: "It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us... There is grandeur in this view of life...." With all certainty, these words would elicit from Nina a sympathetic smile.

Paul Ross

Our world is better off because she inhabited it

In August 1995 I joined the Anthropology program at the University Of Hawai'i as an assistant professor. One of the more substantial changes I experienced in joining the faculty involved meeting Professor Nina L. Etkin. The month before I moved to Honolulu, a senior colleague in the department had warned me with a chuckle (and some appreciation) that Nina was a "tough Russian." Upon meeting, she was cool but collegial; she was also

intimidating. Our relationship really began after I learned, following her student advisees' cue, to call her "Dr. Etkin" and after I became enamoured of her large dog companion Solly. For more than 13 years, Nina and I worked together in various capacities on departmental governance and as committee members for shared students; we lamented over troubled students, we celebrated other students' victories, and we cut losses where we had to. During this process we gradually became friends---tentatively at first because of age, temperamental, and subdisciplinary differences. Nina couldn't resist cracking snide jokes about archaeologists (I countered in kind about cultural anthropologists) and we lobbed

occasional commentary about the madness of our daily lives. We were, in some senses, kindred spirits. Our departmental correspondence transformed as we began to socialize (always more comfortably on the hiking trail than in a restaurant setting). And throughout this process I grew to appreciate what my colleague had described as a "Russian" quality in Nina; she had consistently

high academic standards, she held high expectations of her colleagues, and made constant demands on herself. Nina's gruff exterior belied a deep empathy and



Nina Etkin received the Excellence in Research award from the university system in 2001. (l-r): Jim Bayman, Terry Hunt, Nina Etkin, Geoff White, Chris Yano, and Miriam Stark

appreciation for others, evidenced in the flowers and cards she distributed and in her participation with me in various personal projects to reward and assuage friends and colleagues. She also extended that care to me during times of loss, and also during the five years in which we lived with knowledge of her illness. Words cannot convey the essence of "Dr. Etkin," her dry banter, her wry smile, her love of nature and many things animate, and her passion for this academic world. Our world is better off because she inhabited it, and her legacy will continue beyond all of us.

*Prof. Miriam T. Stark, Archaeologist
Department of Anthropology
University of Hawai'i at Manoa*

In remembrance of Nina Etkin as academic mentor and friend

From Jeremy Spoon

Dr. Nina L. Etkin was my academic mentor and an integral part of my professional development. Many are aware of her work in linking biological and cultural factors to studies on human health in Nigeria and beyond. Instead of focusing on the significant importance of her work in that area, I intend to briefly comment on her influence on my research in environmental anthropology. I completed my PhD in May 2008 at the University of Hawai'i at Manoa under her supervision. My dissertation, entitled *Tourism in a Sacred Landscape: Political Economy and Sherpa Ecological Knowledge in Beyul Khumbu/Sagarmatha (Mount Everest) National Park, Nepal*, focused on how certain political and economic drivers influence Khumbu Sherpa sense of place. Dr. Etkin provided me invaluable guidance in various areas that are not typically associated with her academic work. She was an exemplary anthropologist – her high standards facilitated quality research no matter what the topic, rooted in extended field-stays and the ability to speak a local language. The research design and methods that Dr. Etkin endorsed included adequate sample sizes, triangulation of sources, and linked quantitative and qualitative techniques, as well as survey research. In the domain of traditional/local ecological knowledge (TEK), she demanded a systematic

and informed lens on knowledge, spiritual perspectives, and practices, as well as the physical landscape. Her influence pushed me to engage TEK on various overlapping levels, including botanical, mammalian, and avian species, place-based spirituality, and landscape. Finally, Dr. Etkin encouraged me to search for the influence of various past and present political and economic forces on human-environment relationships. In my research, these drivers of change included market integration through tourism, the advent of a protected area, Western-style education in non-local languages, and ten years of civil war and a subsequent political revolution. My research benefited in many ways from her mentorship, which has made me a more holistic and innovative environmental anthropologist. In Dr. Etkin's memory, it is my honour to continue the lineage of her work not just on the bio-cultural factors influencing human health, but also applied to the discourse on ecological knowledge and its relevance to environmental sustainability.

*Jeremy Spoon, PhD
Assistant Professor
Portland State University*

PhD Thesis:
Spoon, J. (2008) *Tourism in a Sacred Landscape: Political Economy and Sherpa Ecological Knowledge in Beyul Khumbu/Sagarmatha (Mount Everest) National Park, Nepal*. PhD, University of Hawaii at Manoa.



The four students who received their PhD in Anthropology under Nina Etkin at UH- Manoa in May 2008. From l- r: Jonathan D. Baker, Jessica Busch-Sipos, Nina Etkin, Jeremy Spoon, and Heather McMillen

From Jonathan D. Baker

Professor Nina Etkin served as my academic advisor and chaired my PhD committee. I could not have asked for a better mentor, and I consider moving to Hawai‘i to work with her as one of the wisest and most fortuitous decisions I have ever made. The academic rigor and excellence of her work set a high standard towards which I aspire. Her advice and guidance at all stages helped improve my research to a great degree, and also helped me maintain my sanity during the long PhD process.

Nina loved what she did, and through her inquisitive enthusiasm she blurred the distinction between work and play. My favourite memories of her illustrate the intellectual curiosity that infused her life and work. We shared a passion for hiking, and for collecting interesting plant matter (seeds, pods, flowers, etc.) on our journeys. On the trail together, intellectual discussions were interspersed with keen observations of our surroundings; we frequently botanized along the way.



In Nina Etkin's office, on the windowsill: a Kew Gardens coffee mug, converted into plant habitat. Diamond Head crater in the background on the left.

When Nina would fly to the mainland US during autumn, she would collect maple leaves for me, knowing that I missed the changing seasons in Hawai‘i. Correspondence from her nearly always included dried *Bougainvillea* flowers in the envelope. In turn, I gave her unusual seeds I had collected. Sometimes, she would throw some of these into the soil of one of her potted plants, to see if they would grow in her office. The sword bean (*Canavalia gladiata* (Savi) DC.) was particularly successful. Its giant cotyledons loudly scattered dirt a few feet when they

emerged, and for several months the vine climbed around her office windowsill.



A collection of beakers filled with seeds that resided in the office. (Photo: Pam Runestad).

This enthusiastic appreciation was also at the heart of her academic work. A few months ago, when I stopped by her office, she ushered me in and excitedly showed me materials she was gathering on insectivorous plants for a section in her next book. As would be expected, her research was meticulous and thorough. But what I remember most fondly is how happy she was sharing what she had found with me: “Look at this one. Isn't this interesting?”

I deeply appreciate Nina's academic and professional mentoring. But I am most thankful to her for sharing her inquisitive approach to the world. Her attitude of enthusiasm and excitement remains with me, and I look forward to conveying it to my students.

*Jonathan D. Baker, PhD
Lecturer, Department of Anthropology
University of Hawai‘i at Manoa*

Joint Publications:

Etkin N.L., J. D. Baker and J. N. Busch. (2008) Cultural factors influencing therapeutic practice.” In *International Encyclopedia of Public Health*, Vol 2. Kris Heggenhougen and Stella Quah (eds.) San Diego: Academic Press. pp. 56-59.

PhD Thesis:

Baker, J.D. (2008) Kava Tradition and Toxicity: Local and Global Discourses about the Use and Safety of *Piper methysticum* G.Forst. (Piperaceae), an Indigenous Botanical Undergoing Pharmaceuticalization. PhD, University of Hawaii at Manoa

From Heather L. McMillen

Professor Etkin's supervision style combined tough love and unconditional love. Her tone was all business. Her expectations were very high and never compromised. At the same time, she was an unwavering supporter, remarkable editor, and effective motivator. She always came through for me. I always wanted to come through for her, too.

Her quiet example of incredible scholarship motivates me tremendously. Instead of imposing her interests, she always encouraged me to move forward with my own ideas...even when they may not have been purely my own. More than once I experienced the excitement of being "onto something new" and when I began to develop the idea, would find myself reading an article she had written 20 years prior that explained the same thought, only in a more eloquent way. Maybe it didn't occur to her to remind me of that particular article, or maybe she thought I should discover it on my own. It actually seemed not to matter to her. She wanted me to experience the process of growth and discovery. Getting credit for it was irrelevant to her. The magnitude of Nina Etkin's scholarship is matched only by the acute degree of her humility.

Indeed, scholarship was her passion. She was tireless, thorough, and fierce. Nothing held her back---especially not cancer. I remember hearing another student's response to the news, "Oh, *pooor* cancer. It has another thing coming!" Everyone knew better than to cross Professor Etkin. Stupid cancer, didn't *it* know better? We knew she would teach it a thing or two...and she did. She also continued to teach us. She remained active, hyper-productive, and engaged with her students for years until she was finally admitted to the hospital last January.

Unrestrained by disciplinary boundaries or by the false dichotomy of theoretical and applied work, Nina has made a difference in this world. Although her career was within the academy, the questions she chose to pursue were based on real world problems. Her work has, therefore, not only shaped ethnopharmacology, medical anthropology, and ethnobiology; it has also informed international public health,

conservation, and development. Many of her students have gone on to work in these fields. Others continue in the academy. I think I can speak for us all when I say that we recognize how special it has been to work with her and that we are motivated to follow her example and make a difference in this world.

*Heather L. McMillen, PhD
Affiliate Researcher,
People and Plants International*



*Noni flowers and fruit: Morinda citrifolia L.
Rubiaceae*

PhD Thesis

McMillen, H. L. (2008) The Roots of Trade: Local Ecological Knowledge of Ethnomedicines from Tanga, Tanzania Markets. PhD, University of Hawaii at Manoa.

Joint Publications:

Dixon, A. R., H. L. McMillen, and N. L. Etkin (1999) Ferment this: the transformation of noni, a traditional Polynesian medicine (*Morinda citrifolia*, Rubiaceae). *Economic Botany* 53(1):51-68.

Etkin, N. L. and H. L. McMillen (2003) The Ethnobotany of Noni (*Morinda citrifolia* L., Rubiaceae): Dwelling in the Land between La'au Lapa'au and TestiNONIals. 2002 Hawai'i Noni Conference, Hilo, Hawai'i, 2003, pp. 11-16. College of Tropical Agriculture and Human Resources, University of Hawai'i, Honolulu.

From Lisa X. Gollin

My dissertation acknowledgements state, “I would like to express my warmest appreciation to my Ph.D. principal advisor, Prof. Nina Etkin, a scholar and a gentlewoman if ever there was one. She elevated my understanding of ethnopharmacology and provided mentorship far beyond my expectations. On a personal note, I recall reading one of her (many) letters on a heart-pounding, bumpy plane ride to Samarinda. As my plane repeatedly dipped into the brown haze hanging over Kalimantan [in 1997 Borneo was ablaze with wildfires], her pithy and instructive letters kept my spirits aloft. This, as T.G.D. (The Good Doctor) knows, is an appropriate metaphor for her steadfast and encouraging role in the wild ride of my graduate career.”

That was in 2001. Since, my dear professor cum friend has been my regular hiking and, in recent years, walking companion (at a shockingly rapid clip, mind you).



After Lisas comprehensive exam. Ninas comment to this picture: “Seperated at birth?”

“You can sleep after you get your PhD,” was Nina’s response to my exclamation of exhaustion one day copying a stack of assigned articles and threatening to climb on top of the warm, humming copy machine and fall asleep. She saw in me more than I realized in myself, urging me early in my graduate career to present at conferences, pursue major grants and publish.

In 1995 Nina and I travelled to Maluku, Indonesia to conduct pilot research on ethnomedicine. I had a history of researching in Indonesia. It was luxurious to have her fine mind by my side—an incredible opportunity for exchange and shared insights. She provided

a deeper understanding and vocabulary to express observations I made in the past about Indonesian plant-therapies—stray bits of datum with no theoretical connective tissue.

With six weeks in the field and our mutual distaste of rapid assessments, tirelessly we tracked down people to interview. One pitch-black night we took a path leading out of Lohiatala village, our footing uncertain, aided by a failing flashlight. We came to a bend in the road where a tree was so dense with fireflies it cast a lunar glow across the land, momentarily knocking us off our mission, then providing the light needed to direct us to the farmer’s home.



I am forever touched and honoured by Nina’s contribution to my life. Next to an altar in memory of my father’s life I have a new one—a photograph of Nina in her office gazing at then puppy, Musa. Long black hair cascading down her back, the photograph surrounded by the seeds, pods and Job’s tears (*Coix lachryma-jobi*) she often collected on trails. I miss her terribly.

*Lisa Gollin, PhD (by way of NLE)
Projects Director, Cultural Impact Studies
Cultural Surveys Hawai’i Inc.*

PhD Thesis:
Gollin LX. The Taste and Smell of Taban
Kenyah (Kenyah medicine): An Exploration of

Chemosensory Selection Criteria for Medicinal Plants among the Kenyah Leppo' Ke of East Kalimantan, Borneo, Indonesia. Department of Anthropology, University of Hawai'i at Manoa, 2001.

Joint Publication:

Etkin, N.L., L.X. Gollin, D. Binnendyk, and H. Soselisa. (1998) Ethnomedicine in Maluku, Eastern Indonesia. *Cakalele* 7:33-50.



In Memoriam

Nina was such a wonderful person and a gracious lady. I knew her when she was a student since Walter (Lewis) was on her Ph.D. committee at Washington University. We shared an interest in West Africa; particularly since we both knew Nigeria. Later on when she was editing several books I was pleased to be a contributor to a number of these. Both Walter and I were pleased to see how well she was admired by her peers and all the many important contributions she made to her profession. We will miss her as we are sure she will be missed by so many of her colleagues and friends.

Sincerely,
Memory Elvin-Lewis
Professor of Biomedicine in
Microbiology and Ethnobotany
Washington University. St. Louis



Photo: <http://record.wustl.edu/archive/2001/05-18-01/index.html>

Prof. Memory Elvin-Lewis

Joint publications:

Elvin-Lewis M. (1986) Therapeutic rationale of plants used to treat dental infections. Chapter 3, 46-69. In Etkin, N. L. *Plants used in Indigenous Medicine and Diet*. Redgrave Publishers, South Salem, NY

Elvin-Lewis M. (1983) The antibiotic and anticariogenic potential of chewing-sticks. Chapter 11: 201-220. In *The Anthropology of Medicine*, Romanucci-Ross, L., Moerman, D. and Tancredi L.R. (eds). Praeger Publications, New York.



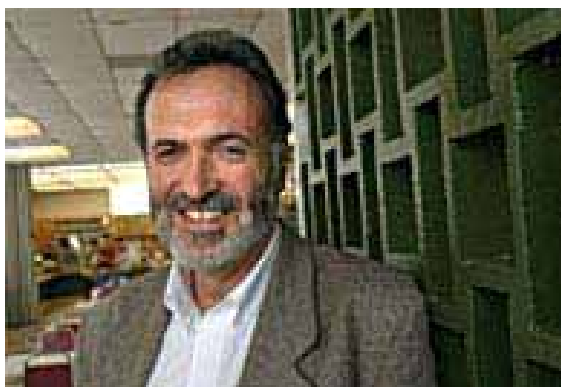
Concepts foreshadowing global developments with important health and social implications

Nina Etkin presented a version of her 1982 paper "Food as medicine and medicine as food: an adaptive framework for the interpretation of plant utilization among the Hausa of northern Nigeria" at the Society of Ethnobiology at the University of Missouri in

March 1981. She spoke immediately before me, but any pre-stage nervousness I felt was superseded by an overwhelming exhilaration and sense of intellectual empowerment at having just understood the implications of my own upcoming presentation. Although we hadn't yet met, Nina had marvellously articulated the defining theme for much of my subsequent scientific career.

From that point we both recognized an intellectual affinity that we nurtured over the

years in various modes, from conversations to symposia to chapters, including those in the seminal books Nina edited, *Plants used Indigenous Medicine and Diet: Bio-behavioural Approaches* and *Eating on the Wild Side: The Pharmacologic, Ecologic and Social Implications of Using Noncultigens*. These volumes were initiated, encouraged and expertly edited by Nina in a manner that generously amplified all of her colleagues. With each being greater than the sum of the component chapters, they were very much held together by the scope of Nina's multi-disciplinary vision and ideas. Although the books were well-received when they appeared, the better indicator of their magnitude is over time how influential they remain. While I personally continued to learn from these collective efforts, in my mind they were most authentically the fuller elaboration and logical outcome of the magical 1982 paper.



Prof. Tim Johns

While Nina's research and professional outputs were initially motivated by pure scientific inquiry and directed at a largely academic audience, they embodied concepts that foreshadowed global developments with important health and social implications. Nina's work provided an important

explanatory framework for the explosion of interest in and use of dietary supplements and functional foods that emerged in the 1990's. Our 1998 paper on this topic "Pharmafoods and Nutraceuticals: Paradigm Shifts in Biotherapeutics" gives me particular pride, partly because of the understanding we were able to articulate, but most markedly as a co-author with a friend who inspired me so profoundly on one first occasion, and then time and time again.

Prof. Timothy Johns
School of Dietetics and Human Nutrition
at McGill University,
Montreal, Québec, Canada

Reference:

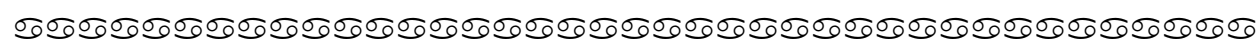
Etkin, N. L. and P. J. Ross. (1982) Food as medicine and medicine as food: an adaptive framework for the interpretation of plant utilization among the Hausa of northern Nigeria. *Social Science and Medicine* 16:1559–1573.

Etkin, N.L., ed. (1986) *Plants in Indigenous Medicine and Diet: Biobehavioural Approaches*. Gordon and Breach Science Publishers. New York

Etkin, N.L., ed. (1994) *Eating on the Wild Side: The Pharmacologic, Ecologic, and Social Implications of Using Noncultigens*. University of Arizona Press. Tucson, Arizona

Joint publication:

Etkin, N.L. and T. Johns. (1998) Pharmafoods and nutraceuticals: paradigm shifts in biotherapeutics. In *Plants for Food and Medicine*. H.D.V. Prendergast, N. L. Etkin, D.R. Harris, and P.J. Houghton, eds. Pp. 3-16. Royal Botanic Gardens Press. Kew, England.



Encouraging student involvement in the ISE

I met Nina at the 2000 ISE congress in Zurich, my first international conference as a first-year Master's student. I was shy and intimidated by the big names of ethnobotany whose book and articles I had studied, yet Nina made me feel

welcome and treated me as a colleague rather than a student. When the ISE general meeting took place, I had recommended that the post of student representative be created on the executive board. Nina was the first to support the idea and nominated me for the position. Nina and my supervisor Timothy Johns had collaborated on numerous projects in the past and she once referred to him as her academic

brother. To have her backing at such an early stage in my academic career filled me with pride and honour, powerful sentiments that hearten a young researcher's resolve to continue along the path. Nina always encouraged student involvement in the ISE and suggested that I write a column discussing the difficulties endured by students studying multidisciplinary sciences such as ethnopharmacology, and having to frame their work inside the strictly defined disciplinary boundaries of university departments. The following year, Nina helped organize the unforgettable Building Bridges with Traditional Knowledge II in Honolulu, a conference I dreamed to attend but was unlikely to because of prohibitively expensive airfare from Montreal. The epitome of my respect and admiration Nina occurred when she suggested I present my review on student struggles in ethnosciences at the conference, and as an invited speaker, would have airfare and accommodation provided for. My gratitude was beyond measure and the experience I had was one of the best. When I saw her at subsequent conferences, I always thanked her for that opportunity.

I am truly sad and disappointed that I will not have another opportunity to see Nina. I would've liked to tell her that from just the few conversations we've had together, she was an inspiration and role model. I can only imagine what kind of influence she must have had on all the grad students and colleagues that

worked more closely with her. My deepest sympathies to her friends and family.

*Patrick Owen, Ph.D.
School of Dietetics and Human Nutrition
McGill University
Montreal, Québec, Canada*



Patrick Owen in Papua New Guinea (2005) interviewing traditional healers on the plants they use to treat symptoms related to diabetes.

Owen P. L. (2001) Graduate studies in ethnopharmacology: bridging the intellectual chasm between the natural and social sciences. *ISE Newsletter* 1(1): 8.

Owen P. L. (2001) Graduate studies in ethnopharmacology - building bridges between disciplines. Building Bridges with Traditional Knowledge II, Honolulu, Hawai'i, USA, 28 May – 1 June, 2001.



Reminding us what the discipline is all about

I have often heard that contacts are perhaps the most relevant benefit one gets from attending scientific congresses. In the astounding city of Strasbourg, way back in 1990, I was by chance sitting next to Nina Etkin when Laurent Rivier was listing candidates for the first ISE board, the society just born. He mentioned the importance of having an anthropological view in Ethnopharmacology issues and proceeded with the call for names. I readily raised my hand and proposed the name of Dr. Darell Posey. Dr. Rivier politely pointed out we had Prof. Nina Etkin in the audience, and following

his sight I found Nina (with Paul next to her) with her hand midway in the air, but timidly bouncing her head signalling she would accept the nomination. Apologetics, therefore, were my first words to Nina when I had the chance to introduce and excuse myself, explaining I had no idea who she was. Working in the Amazon in a time when immediate access to literature was not even available in science fiction, I told her I in fact had never heard of her. I guess we soon identified with each other, the candidness, the humor...

From that point on I began reading Nina's papers and, as others in the field, I was certainly influenced by her thoughtful elegant work. Nina kept reminding us what the

discipline is all about: “theory-driven and context-sensitive study of the pharmacologic potential of species used by indigenous peoples for medicine, food, and other purposes,” “shift current biodiversity management strategies from economic concerns to issues that bear on ecological and environmental health,” “assist the conservation of species that indigenous peoples regard as important, rather than focus on species that have been identified by outsiders who are politically and culturally remote from the threatened environments”.

collaborating in a couple of projects, and just the pleasure of getting to know her, was yet another unexpected gift from being an ethnopharmacologist. Over the years we had stimulating scientific discussions and a fair amount of fun in different places and its surrounding cultures. Little did I know back in 1990 how much I could gain from attending a scientific congress. I sure knew then, as I know now, how priceless is a friend. I am afraid it will never again be as good.

*Prof. Elaine Elisabetsky
Honorary Board Member, ISE*



Nina and Elaine at the medicinal plant garden, Nanning P.R. China, 2006

Having the chance of spending a few days together nearly every two years,

Joint publications:

Etkin, N. L. and E. Elisabetsky (2005) Seeking a transdisciplinary and culturally germane science: the future of ethnopharmacology *Journal of Ethnopharmacology* 100: 23-26.

Elisabetsky, E. and N.L. Etkin, Honorary Theme eds. (several in 2005, 2006) *UNESCO On-line Encyclopedia: Global Sustainable Development, Water, Energy, Environment, Food & Agriculture, Knowledge Foundations*. UNESCO/EOLSS. Oxford, England. [<http://www.eolss.net>].



A passion for high standards



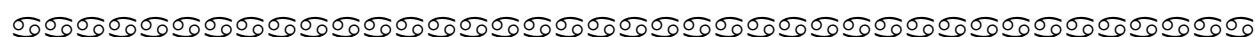
My first recollection of Nina was as a fellow member of the ISE committee as we prepared for the meeting in London in 1996. She was not afraid of expressing her views and had a passion for high standards in research and the need for integration across the wide spectrum

of expertise that comprises ethnopharmacology. Over the last 10 years my respect developed into friendship and I particularly enjoyed spending time with her and Paul at the meeting in Nanning in 2006. I treasure several photographs taken with her at various meetings and share in the sadness at the loss to ethnopharmacology that her death has brought.

*Prof. Peter Houghton
Treasurer, ISE*

Joint Publication:

Prendergast, H.D.V. and N. L. Etkin, D.R. Harris, and P.J.Houghton, eds. (1998) *Plants for Food and Medicine*. Royal Botanic Gardens Press. Kew, England.



A sparkling reminder of a vivid interest in all scholarly questions relating to human interaction with the environment

Nina's Email to Peter Houghton and Michael Heinrich on 17.10.08:

*Hello Peter and Michael,
I am writing about Charles Darwin, and would like to "fact check" with you. Is the following correct?
"The more familiar icons of legend appear on the ten-pound British sterling note that bears Darwin's image (issued in 2000): over the backdrop of a compass, the Beagle navigates blue waters off the Galapagos archipelago, a hummingbird hovers, and only a prosaic magnifying glass alludes to the essence of a rigorous research program."
Oh, come on, this must be more entertaining than students' papers.
I am "the same" -- which is the best I can expect, still hiking.
I missed friends and colleagues at the Brazil meeting, and otherwise, and am very pleased for Elaine that it went well.
Best,
Nina*

Having met Nina for the first time about twenty years ago, her last email sent 17.10.08, is a sparkling reminder of her vivid interest in all scholarly questions relating to how we humans interact with the environment. And this is Nina---sharp and right to the point.

Without doubt her research has had considerable impact on the development of my scientific thinking and will certainly do so in the future. She always has been an enthusiastic and critical discussant and a scholar keenly interested in ethnopharmacology. One of her interests which connected us was her concern about ascertaining that ethnopharmacology is a 'theory-driven and context-sensitive study of the pharmacologic potential of species used by indigenous peoples for medicine, food, and other purposes' (Etkin and Elisabetsky 2005).

Her earlier work (published jointly with her husband Paul Ross) influenced many of the current researchers in the area and her visionary perspective on the integration of food and medicine is much better understood today

than when it was first published: *Food as Medicine and Medicine as Food: An adaptive framework for the interpretation of plant utilisation among the Hausa of Northern Nigeria* (Etkin and Ross 1982).

In later years she pioneered links between the study of pharmaceutical and medicinal plant usage in indigenous communities, an area of research which is still underdeveloped (Etkin et al. 1990). Other interests were linked with medical research and more specifically the interface of human physiology and biological anthropology (Etkin et al 1982).

All her works were at the same time very stimulating and a challenge to read. Her well-written articles and books are, without doubt, one of her most important legacies. At the same time, she was a unique personality, reluctant and withdrawn at the beginning of a conversation but also very warm and an engaging, and an engaged biocultural scientist. We all miss her.

*Prof. Michael Heinrich
President ISE (2008-2010)*



Nina and Paul in a taxi, saying good-bye after the ICE Nanning conference, 2006

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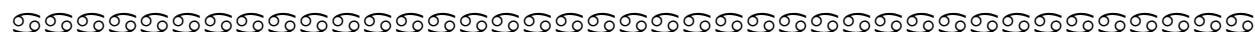
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Etkin, N.L. (2005) Review of *Fundamentals of Pharmacognosy and Phytotherapy*, by Michael Heinrich, Joanne Barnes, Simon Gibbons, and Elizabeth M. Williamson. *Economic Botany* 59:405.

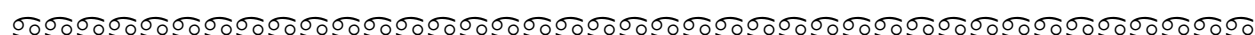


Collaborating where necessary and consulting literature outside one's own professional disciplines

As a young lecturer, I listened to a plenary talk Nina Etkin gave at the ISE 'Ethnopharmacology 2000: Challenges for the New Millenium' conference in Zürich (2000). Nina talked about the lack of interdisciplinarity in ethnopharmacological studies, and more importantly stressed that scientific discoveries of pharmacological effects of medicinal plants were not sufficiently placed in the cultural context, not benefitting the populations using the plants. She wrote in the abstract *'Specifically, we suggest that ethnopharmacologists of all backgrounds*

project pharmacologic data against a backdrop of medical ethnography (e.g., by addressing therapeutic objectives, specific contexts of use, preparation, etc.), and enrich cultural interpretations of medicinal actions by exploring the physiologic potential of plants – collaborating where necessary and consulting literature outside their own professional disciplines.' At this talk, Nina planted the thoughts in me that over the years have shaped my understanding of how our field, Ethnopharmacology, ideally should be. I know very well how difficult it is to give back scientific information to healers and their patients – but maybe in honour of Nina Etkin we should all just try a little more.

Anna K Jäger
ISE Board member, auditor



The crème de la crème of ethnopharmacology

Nina was a highly critical and courageous scientist. For us, these characteristics are best illustrated in her article "Perspectives in ethnopharmacology: forging a closer link between bioscience and traditional empirical knowledge" (2001) where she demands a true interdisciplinarity in ethnopharmacological research. In analyzing the contents of the *Journal of Ethnopharmacology* from its beginning in 1979 she criticized that "whereas

the published articles represent the breadth of natural and social science, most studies are themselves not synthetic or interdisciplinary. Very few combined pharmacologic data with sufficient ethnographic depth to make substantive statements about how specific plants influence the health of a particular population." (p. 178). She found that only 6 percent of all articles published in JEP between 1979 and 1996 could be truly called "interdisciplinary" – a trend that was perpetuated in the years 1996-2000, where the number declined to 4 percent. "The point is that interdisciplinary studies effectively

combine ethnography and pharmacology to formulate meaningful conclusions” (p. 180). Furthermore she criticizes that “many authors still position their research in a Western pharmaceutical frame without considering the implications for populations” and that “ethnopharmacology has not been appreciably influenced by the very public and political attention to biodiversity, ethics and intellectual property rights” (p. 180). “What is more disturbing now is that most researchers appear to have no objective at all, at least most authors do not state what the purpose of their research is. (...) By all appearances, no one seems to reflect much on what the larger picture might be” (p. 181). She concludes: “How can we reconcile that research conducted during the last two decades has yielded an enormous amount of information on plant constituents and activities with virtually no practical application?” (p. 181)

Perfect! This is Nina at her best. Sharp, courageous, incorruptible.

We are using many of Nina’s articles (especially 1992) and books in our lectures and seminars, but this article we find most characteristic for her strength, her courage and her scholarly anger. She always did what she demanded of others---doing extensive fieldwork, truly working interdisciplinarily, being as much a cultural anthropologist as a natural scientist. And, apart from that, she was an excellent mentor, supporting, encouraging and paying attention to detail.

I (Ruth) once wrote a manuscript on the indigenous use of water beetles and asked Nina if she could go through it and advise me on where to publish it. I had met her at a conference in Costa Rica, where Armin introduced us, but we did not know each other very well so I was a bit shy to write her. For me she was (and still is!) the crème de la crème of ethnopharmacology and I actually did not even expect her to answer my mail. But there it came; she gave me enormously useful and encouraging feedback. I did as she suggested and sent the article to the Journal of Ethnobiology. When the journal’s editors sent the manuscript to her for review (she was on the editorial board) she rejected to do so because of personal bias. I don’t remember the actual words but she wrote something like “I know this person too well, please send it to

another reviewer.” This was a reply I found somehow meticulous at first reaction, but later deeply impressed me. For me, this small incident shows so well Nina’s integrity, and her supportive and unwavering nature. (The paper was then sent to another reviewer and accepted by JEB.)

For Nina the biologist, Hawaii was the ideal place to live her closeness to nature. In her house, huddled against the mountain, she lived amidst her plants. In every letter she wrote she would enclose a dried flower. We will miss her.

*Prof. Armin Prinz and Dr. Ruth Kutalek
Unit of Ethnomedicine
and International Health
Center for Public Health
Medical University of Vienna*

*See also: viennese ethnomedicine newsletter
ven, where Nina served as member of the
editorial board
<http://www.univie.ac.at/ethnomedicine/>*



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Joint publications:

Etkin, N.L. and P.J. Ross (2006) The health implications of foraged and fermented foods.

In Hunting Food and Drinking Wine. A. Prinz, ed. Pp. 73-81. Lit Verlag. Vienna.

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Nina's traces in Germany

In German speaking countries ethnobotany and ethnopharmacology do not take up an important place in academic life. That is a pity, because Germany has a large cultural tradition of ethnobotanical practice, and Nina represented the best tradition of ethnological studies on plant medicine in an academic framework, combining sciences as well as arts. The importance of the plants for the history of mankind is enormous, so that you could say, the history of mankind is at the same time also the history of plant use in daily life. Nina showed the importance of this role of plants not only in healing, but also in dietetics, prevention, and cosmetics. And you could easily broaden up this scope into religion and healing rituals. Nina herself knew this well, but she remained in her special scope of interest. She also considered botanical and biochemical interpretations of the effects of plants, in order to better understand the cultural details of her findings, thereby providing a good example of what the crux of interdisciplinary work is.

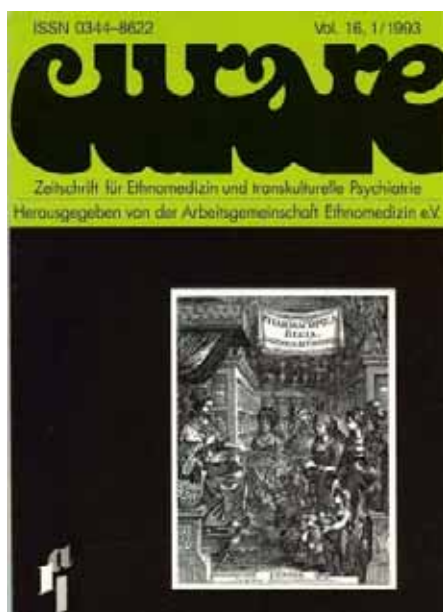
In March 1993 we had the chance to invite her to Heidelberg, to our 11th "Ethnomedizin" conference, the German academic tradition of discourse in all fields of medical anthropology at that time (see her presentation Etkin and Ross 1993b, 1996). We know that her article which she presented at the 1st ISE conference in the founding year of the ISE remarkably echoes its German translation in *Curare* in 1993, prepared especially for our conference (Etkin and Ross 1993a). After visiting Strasbourg in 1990, Nina enjoyed being in Heidelberg in 1993, with its old university, just on the other side of the Upper Rhine. She also liked the hotel in the

medieval building at Neckargmünd near Heidelberg, where most of the guests at the conference were living. I remember her appreciation of the breakfast view over the Neckar river that runs between the narrow hills there, and the lights of early spring. She did not speak about the landscape much, because the conference talk in the Museum of Ethnology in the centre of Old Heidelberg came afterwards. She only commented, "How beautiful," not only on the daily blue sky, but also on the blossoms of the Hawaii bougainvillea. These blossoms were used here for decoration of the breakfast room, and she gave me such a blossom. Thank you Nina.

Ekkehard Schröder
Editor of Curare,
Journal of Medical Anthropology
(founded by AGEM in 1978)

References and joint publications:

Etkin, Nina und Paul J. Ross (1993a) Brauchen wir einen Platz für Ernährungsgewohnheiten und Diätetik in der Ethnopharmakologie. *Curare* 16,1: 3-16 (translated version from Etkin, N.: Should we set a place for diet in Ethnopharmacology? *Journal of Ethnopharmacology*, 32 (1991) 25-36 (from a paper presented at the first International Congress of Ethnopharmacology 1990 at Strasbourg).



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Calling for a readjustment of the balance between the various disciplines involved in ethnopharmacology

Nina Etkin made an invaluable contribution to the development of ethnopharmacology. Her competence as an anthropologist shed precious light on her work. She also found ways to build bridges between the humanities and life sciences and thus promoted interdisciplinary studies that serve as a platform for research in ethnopharmacology.

She repeatedly called for a readjustment of the balance between the various disciplines involved in ethnopharmacology and appropriately advocated more involvement by ethnologists in this area of studies.

She was one of the key figures from the U.S. to contribute actively to the Congress of the European Society for Ethnopharmacology and Société Française d'Ethnopharmacologie, in particular on the occasion of the Heidelberg, Germany (1) and the Genoa, Italy (2) conferences. Her numerous publications are considered as essential for our discipline. All those who had

the privilege of meeting her and becoming her friend will always remember her joviality and her enthusiasm.

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*Dr. Jacques Fleurentin
President of
Société Française d'Ethnopharmacologie -
French Society for Ethnopharmacology
Metz, France*

See also:

<http://www.ethnopharmacologia.org/>
<http://www.jardinsdumonde.org/>
<http://www.ethnopharmacologia.org/default.asp?page=revue>

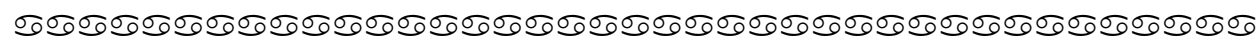


A sharp and critical mind that immediately recognized if a study was of high quality

Unfortunately I never had the chance to meet Nina Etkin, but I certainly do know her from the many reviews she wrote on manuscripts submitted to JEP. It was clear that she had a sharp and critical mind that immediately recognized if a study was of high quality. She dissected papers almost like a surgeon, pointing out weaknesses but at the same time giving advice to do better next time. So many authors profitted by her efforts, and so did the

journal, as we can see a continuous increase in the quality of the papers. A reviewer like Nina is an enlightening example for the younger generation, showing us the meaning of academic duties and how to practice these to the benefit of the society. Her spirit will thus stay with us, and her scientific heritage will remain a source of inspiration for researchers in the field of ethnopharmacology.

*Prof. R. Verpoorte
Editor-in-Chief,
Journal of Ethnopharmacology*



Articles published by Nina L. Etkin in the Journal of Ethnopharmacology

Seeking a transdisciplinary and culturally germane science: The future of ethnopharmacology, *Journal of Ethnopharmacology, Volume 100, Issues 1-2, 22 August 2005, Pages 23-26*. Nina L. Etkin, Elaine Elisabetsky.

Quality Standards of Indian Medicinal Plants, Volume 1: Indian Council of Medical Research, ICMR, New Delhi, India, 2003, xvi + 262 pp., 32 Chapters and colour plates, 6 Appendices, 3 Indices, US\$ 40.00, hard cover, ISSN: 0972-7213. *Journal of Ethnopharmacology, Volume 90, Issues 2-3, February 2004, Page 422*, Nina L. Etkin.

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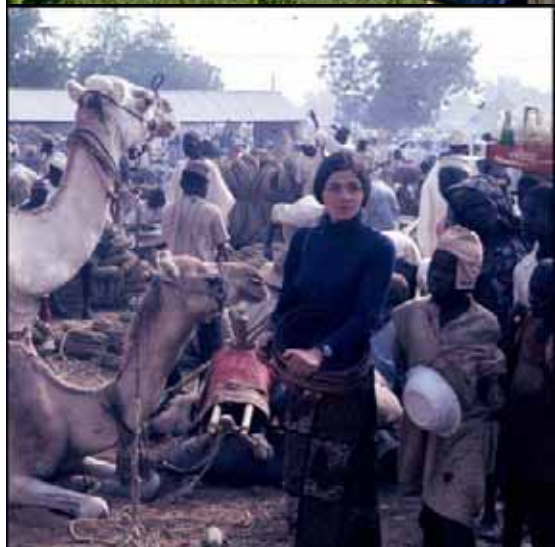
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*Irene Kanter-Schlifke, PhD
Publishing Editor, Pharmacology & Pharmaceutical Sciences
Journal Development and Support, ELSEVIER - www.elsevier.com*

The enclosed articles (attachment) by Nina Etkin have been made available by Elsevier B.V. for inclusion in this ISE Newsletter We are very grateful to Dr. Irene Kanter-Schlifke for her help and support.







Nina L. Etkin's Publication List



PH.D. DISSERTATION

1975: The Human Red Cell, Glucose-6-Phosphate Dehydrogenase Deficiency, and Malaria.

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- 2001: **Etkin, N.L.** Review of *The Natural History of Medicinal Plants*, by Judith Sumner. Timber Press. Portland, Oregon. *Quarterly Review of Biology* 76(4):480-481.
- 2000: **Etkin, N.L.** and P.J. Ross. The Ethnopharmacology of Fermented Medicinal Foods. In *Proceedings of the International Symposium on Ethnobotany, Medicinal Plants, Folk Traditions: Ethnomedicine, History, and Pharmacology*. R. Chaves, ed. Universidad Para La Paz. San José, Costa Rica. CD-ROM.
- 1999: **Etkin, N.L.** Papers at a Conference. *VEN: Viennese Ethnomedicine Newsletter* II:3-5.
- *1999: **Etkin, N.L.**, A.R. Dixon, P.W. Nishimoto, and P.J. Ross. Medicinal Foods in Multiethnic Honolulu, Hawaii. In *Cultural Food*. A. Guerici, ed. Pp. 12-26. Erga Edizioni. Genoa, Italy.
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- *1999: **Etkin, N.L.**, P.J. Ross, and I. Muazzamu. The Rational Basis of “Irrational” Drug Use: Pharmaceuticals in the Context of “Development.” In *Anthropology in Public Health*. R.A. Hahn, ed. Pp. 165-181. Oxford University Press. Oxford.
- *1998: **Etkin, N.L.** Indigenous Patterns of Conserving Biodiversity: Pharmacologic Implications. *Journal of Ethnopharmacology* 63(3):233-245.
- 1998: **Etkin, N.L.** and T. Johns. Pharmafoods and Nutraceuticals: Paradigm Shifts in Biotherapeutics. In *Plants for Food and Medicine*. H.D.V. Prendergast, N. L. Etkin, D.R. Harris, and P.J. Houghton, eds. Pp. 3-16. Royal Botanic Gardens Press. Kew, England.
- *1998: **Etkin, N.L.**, L.X. Gollin, D. Binnendyk, and H. Souselisa. Ethnomedicine in Maluku, Eastern Indonesia. *Cakalele* 7:33-50. (backdated 1996)
- *1997: **Etkin, N.L.** and P.J. Ross. A Discipline Maturing: Past Trends and Future Direction in Ethnopharmacology. In *Salute e Malattia: Indirizzi e Prospettive*. A. Guerici, ed. Pp. 85-95. Erga Edizioni. Genoa, Italy.
- 1997: **Etkin, N.L.** Protecting Habitats for Medicinal Plants and Local Populations. In *Herbal Medicine: A Holistic Approach*. D.A. Wozniak, S. Yuen, M. Garrett, and T.M. Shuman, eds. Pp. 260-287. International Institute for Human Resources Development. San Diego State University. San Diego, CA.
- 1997: **Etkin, N.L.** Drugs and Traditional Medicines. In *The Encyclopedia of Africa South of the Sahara*. Volume 2. J. Middleton, ed. Pp. 283-286. Scribner Publishers. New York.
- *1997: **Etkin, N.L.** Plants as Antimalarial Drugs: Relation to G6PD Deficiency and Evolutionary Implications. In *Adaptation to Malaria: the Interaction of Biology and Culture*. L.S. Greene and M.E. Danubio, eds. Pp. 139-176. Gordon and Breach Science Publishers. New York.
- 1997: **Etkin, N.L.** Medicinal Food Plants. In *The Encyclopaedia of the History of Science, Technology and Medicine in Non-Western Cultures*. H. Selin, ed. Pp. 676-679. Kluwer Publishers. Dordrecht, The Netherlands.

- 1997: **Etkin, N.L.** and P.J. Ross. Reframing Studies of Plant Medicines. In *Guarire, Ieri e Oggi. Domani? Healing Yesterday and Today. Tomorrow?* A. Guerici, ed. CD-ROM. Erdi Multimedia. Genoa, Italy.
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- 1997: **Etkin, N.L.** and P.J. Ross. Malaria, Medicine and Meals: A Biobehavioral Perspective. In *The Anthropology of Medicine*. 3rd edition. L. Romanucci-Ross, D.E. Moerman, and L.R. Tancredi, eds. Pp. 169-209. Praeger Publishers. New York.
- *1996: **Etkin, N.L.** Medicinal Cuisines: Diet and Ethnopharmacology. *International Journal of Pharmacognosy* 34(5):313-326.
- *1996: Ross, P.J., **N.L. Etkin**, and I. Muazzamu. A Changing Hausa Diet. *Medical Anthropology* 17:143-163.
- 1996: **Etkin, N.L.** Review of *Ethnobotany and the Search for New Drugs*. CIBA Foundation Symposium 185, edited by Derek J. Chadwick and Joan Marsh. *Journal of the Royal Anthropological Institute* 2(4):748-749.
- *1996: **Etkin, N.L.** Ethnopharmacology. In *The Encyclopedia of Cultural Anthropology*. D. Levinson and M. Ember, eds. Pp. 443-447. Human Relations Area Files and Henry Holt Publishers. New York.
- 1996: **Etkin, N.L.** Ethnopharmacology: The Conjunction of Medical Ethnography and the Biology of Therapeutic Action. In *Medical Anthropology: Contemporary Theory and Method*. Revised edition. C.F. Sargent and T.M. Johnson, eds. Pp. 151-164. Praeger Publishers. New York.
- 1996: **Etkin, N.L.** Ethnopharmacologic Perspectives on Diet and Medicine in Northern Nigeria. In *Médicaments et Aliments: Approche Ethnopharmacologique*. E. Schröder, G. Balansard, P. Cabalion, J. Fleurentin, and G. Mazars, eds. Pp. 58-62. Société Française d' Ethnopharmacologie. Metz, France.
- *1995: Spring, M.A., P.J. Ross, **N.L. Etkin**, and A.S. Deinard. Sociocultural Factors in the Use of Prenatal Care by Hmong Women, Minneapolis. *American Journal of Public Health* 85:1015-1017.
- 1995: **Etkin, N.L.** Review of *Edible Wild Plants of Sub-Saharan Africa*, by Charles R. Peters, Eileen M. O'Brien, and Robert B. Drummond. *Journal of Ethnobiology* 15(1):87-88.
- 1995: **Etkin, N.L.** Review of *Kava: The Pacific Drug*, by Vincent Lebot, Mark Merlin, and Lamont Lindstrom. *The Contemporary Pacific* 7(1):218-221.
- *1995: **Etkin, N.L.** Ethnopharmacologic Perspectives on Diet and Medicine in Northern Nigeria. *Curare* 16(3&4):207-210.
- 1994: **Etkin, N.L.** The Cull of the Wild. In *Eating on the Wild Side: The Pharmacologic, Ecologic, and Social Implications of Using Noncultigens*. N.L. Etkin, ed. Pp. 1-21. University of Arizona Press. Tucson.
- 1994: **Etkin, N.L.** and P.J. Ross. Pharmacologic Implications of 'Wild' Plants in Hausa Diet. In *Eating on the Wild Side: The Pharmacologic, Ecologic, and Social Implications of Using Noncultigens*. N.L. Etkin, ed. Pp. 85-101. University of Arizona Press. Tucson.
- 1994: **Etkin, N.L.** The Negotiation of "Side" Effects in Hausa (Northern Nigeria) Therapeutics. In *Medicines: Meanings and Contexts*. N.L. Etkin and M.L. Tan, eds. Pp. 17-32. University of Amsterdam. Amsterdam.
- 1994: **Etkin, N.L.** Depending on Fulbright: One Researcher's Experience in Northern Nigeria. In *Fulbright Experience in Benin [sic Nigeria]*. F.A. Salamone, ed. Pp. 65-76. Studies in Third World Societies/College of William and Mary. Williamsburg, VA.
- *1994: **Etkin, N.L.** Consuming a Therapeutic Landscape: A Multicontextual Framework for Assessing the Health Significance of Human-Plant Interactions. *Journal of Home and Consumer Horticulture* 1(2/3):61-81.
- *1994: **Etkin, N.L.** Consuming a Therapeutic Landscape: A Multicontextual Framework for Assessing the Health Significance of Human-Plant Interactions. In *People-Plant Relationships: Setting Research Priorities*. J. Flagler and R. Poincelot, eds. Pp. 61-81. Haworth Press. Binghamton, NY.
- 1994: Tan, M.L. and **N.L. Etkin**. Introduction. In *Medicines: Meanings and Contexts*. N.L. Etkin and M.L. Tan, eds. Pp. 1-8. University of Amsterdam. Amsterdam.

- *1993: **Etkin, N.L.** and B.A. Meilleur. Ethnomedicine in Polynesia: Past Trends and Future Directions. *Journal de la Société des Oceanistes* 96:19-27.
- *1993: **Etkin, N.L.** Anthropological Methods in Ethnopharmacology. *Journal of Ethnopharmacology* 38:93-104.
- *1993: **Etkin, N.L.** and P.J. Ross. Brauchen wir einen Platz für Ernährungsgewohnheiten und Diätetik in der Ethnopharmakologie? *Curare* 16(1):3-16.
- 1992: **Etkin, N.L.** Review of *With Bitter Herbs They Shall Eat It: Chemical Ecology and the Origins of Human Diet and Medicine*, by Timothy Johns. *Journal of the History of the Behavioral Sciences* 28:390-392.
- *1992: **Etkin, N.L.** Side Effects: Cultural Constructions and Reinterpretations of Western Pharmaceuticals. *Medical Anthropology Quarterly* 6:99-113.
- 1992: **Etkin, N.L.** Review of *Essential Medical Genetics*. 3rd edition, by J.M. Connor and M.A. Ferguson-Smith. *Human Biology* 64(3):463-464.
- *1991: Ross, P.J., **N.L. Etkin**, and I. Muazzamu. The Greater Risk of Fewer Deaths: an Ethnodemographic Approach to Child Mortality in Hausaland. *Africa* 61(4):502-512.
- 1991: **Etkin, N.L.** and P.J. Ross. Recasting Malaria, Medicine, and Meals: A Perspective on Disease Adaptation. In *The Anthropology of Medicine*. 2nd edition. L. Romanucci-Ross, D.E. Moerman, and L.R. Tancredi, eds. Pp. 230-258. Praeger Publishers. New York.
- 1991: **Etkin, N.L.** Review of *Herbal Medicine Past and Present*, by J.K. Crellin and J. Philpott. *Medical Anthropology Quarterly* 5(3):286-288.
- 1991: **Etkin, N.L.** Review of *A Continuing Trial of Treatment: Medical Pluralism in Papua New Guinea*, edited by S. Frankel and G. Lewis. *The Contemporary Pacific* 3(2):457-458.
- *1991: **Etkin, N.L.** and P.J. Ross. Should We Set a Place for Diet in Ethnopharmacology? *Journal of Ethnopharmacology* 32:25-36.
- *1991: **Etkin, N.L.** The Behavioral Dimensions of Malaria Control: Guidelines for Culturally Sensitive and Microecologically Germane Policies. In *Malaria and Development in Africa: A Cross-Sectoral Approach*. American Association for the Advancement of Science SubSaharan Africa Program, eds. Pp. 59-69. AAAS. Washington, DC.
- *1991: **Etkin, N.L.** Behavioral Dimensions of Malaria Control. In *La Malaria et le Developpement en Afrique: Une Approche Intersectorielle*. L'Association Americaine pour l'Avancement des Sciences, eds. AAAS. Washington, DC.
- 1990: **Etkin, N.L.** Ethnopharmacology: Biological and Behavioral Perspectives in the Study of Indigenous Medicine. In *Medical Anthropology: A Handbook of Theory and Method*. T.M. Johnson and C.F. Sargent, eds. Pp. 149-158. Praeger Publishers. New York.
- *1990: Iwalewa, E.O., L. Lege-Oguntoye, P.P. Rai, T.T. Iyaniwura, and **N.L. Etkin**. *In vitro* Antimalarial Activity of Leaf Extracts of *Cassia occidentalis* and *Guiera senegalensis* in *Plasmodium yoelii nigeriensis*. *West African Journal of Pharmaceutical and Drug Research* 9:19-21.
- 1990: **Etkin, N.L.** and P.J. Ross. Plant Use among the Hausa and Its Impact on Disease. In *The Anthropology of Medicine*. Japanese translation. L. Romanucci-Ross, D.E. Moerman, and L.R. Tancredi, eds. UNI Agency. Tokyo.
- 1990: **Etkin, N.L.** Review of *The Professionalisation of African Medicine*, edited by M. Last and G.L. Chavunduka. *American Anthropologist* 92:809-810.
- *1990: **Etkin, N.L.**, P.J. Ross, and I. Muazzamu. The Indigenization of Pharmaceuticals: Therapeutic Transitions in Rural Hausaland. *Social Science and Medicine* 30(8):919-928.
- 1989: **Etkin, N.L.** Review of *Hausa Medicine*, by Lewis Wall. *Africa* 59(4):533-535.
- *1988: **Etkin, N.L.** Ethnopharmacology: Biobehavioral Approaches in the Anthropological Study of Indigenous Medicines. *Annual Review of Anthropology* 17:23-42.
- 1988: **Etkin, N.L.** Cultural Constructions of Efficacy. In *The Context of Medicines in Developing Countries*. S. van der Geest and S.R. Whyte, eds. Pp. 299-326. Kluwer. Dordrecht, The Netherlands.
- 1986: **Etkin, N.L.** Multidisciplinary Perspectives in the Evaluation of Plants Used in Indigenous Medicines and Diet. In *Plants in Indigenous Medicine and Diet: Biobehavioral Approaches*. N.L. Etkin, ed. Pp. 2-29. Gordon and Breach Science Publishers. New York.

- 1983: **Etkin, N.L.** and P.J. Ross. Malaria, Medicine, and Meals: Plant Use among the Hausa and Its Impact on Disease. In *The Anthropology of Medicine*. L. Romanucci-Ross, D.E. Moerman, and L.R. Tancredi, eds. Pp. 231-259. Praeger Publishers. New York.
- 1983: **Etkin, N.L.** Health Care in the Mid-South. In *Memphis, The Mid-South, and the Mississippi Valley*. C. Crawford and E. Fruchtmann, eds. Reference Collection, Archives of the Mississippi Valley Collection. Brister Library. University of Memphis. Memphis, Tennessee.
- *1983: **Etkin, N.L.**, J.W. Eaton, O. Gomez-Marin, R. Prineas, and R. Gillum. Red Cell Sodium Permeability and Blood Pressure: Minneapolis Children's Blood Pressure Study. Abstract. *Cardiovascular Disease Newsletter* 3:25.
- *1982: **Etkin, N.L.** and P.J. Ross. Food as Medicine and Medicine as Food: An Adaptive Framework for the Interpretation of Plant Utilization among the Hausa of Northern Nigeria. *Social Science and Medicine* 16:1559-1573.
- *1982: **Etkin, N.L.**, J.R. Mahoney, M.W. Forsthoefel, J.R. Eckman, J.D. McSwigan, R.F. Gillum, and J.W. Eaton. Racial Differences in Hypertension-Associated Red Cell Sodium Permeability. *Nature* 297:588-589.
- *1982: Mahoney, J.R., **N.L. Etkin**, J.D. McSwigan, and J.W. Eaton. Assessment of Red Cell Sodium Transport in Essential Hypertension. Abstract. *Blood* 59(2):439-442.
- *1982: Mahoney, J.R., **N.L. Etkin**, J.D. McSwigan, M.W. Forsthoefel, J.R. Eckman, and J.W. Eaton. Racial Differences in Hypertension-Associated RBC Na⁺ Permeability. Abstract. *Clinical Research* 30(2):338a.
- *1981: Mahoney, J.R., **N.L. Etkin**, J.D. McSwigan, and J.W. Eaton. Abnormal Red Cell Cation Permeability in Essential Hypertension. Abstract. *Blood* 58:31a.
- *1981: **Etkin, N.L.** A Hausa Herbal Pharmacopoeia: Biomedical Evaluation of Commonly Used Plant Medicines. *Journal of Ethnopharmacology* 4:75-98.
- *1980: **Etkin, N.L.** Indigenous Medicine in Northern Nigeria. Oral Hygiene and Medical Treatment. *Journal of Preventive Dentistry* 6:143-149.
- *1979: **Etkin, N.L.** Introduction: Biomedical Evaluation of Indigenous Medical Practices. *Medical Anthropology* 3(4):393-400.
- *1979: **Etkin, N.L.** Indigenous Medicine among the Hausa of Northern Nigeria: Laboratory Evaluation for Potential Therapeutic Efficacy of Antimalarial Plant Medicinals. *Medical Anthropology* 3(4):401-429.
- *1975: **Etkin, N.L.** and J.W. Eaton. Malaria-Induced Erythrocyte Oxidant Sensitivity. In *Erythrocyte Structure and Function*. G.J. Brewer, ed. Pp. 219-232. Alan R. Liss Publishers. New York.
- *1972: Eaton, J.W., M. Boraas, and **N.L. Etkin**. Catalase Activity and Red Cell Metabolism. In *Hemoglobin and Red Cell Structure and Function*. G.J. Brewer, ed. Pp. 121-130. Plenum. New York.



CURRICULUM VITAE

PROFESSIONAL PREPARATION

Ph.D. Washington University. St. Louis, Missouri. 1975 - Anthropology
 M.A. Washington University. St. Louis, Missouri. 1972 - Anthropology
 B.A. Indiana University. Bloomington, Indiana. 1970 - Zoology

RESEARCH AND EMPLOYMENT

Administration/Teaching

Graduate Chair, Department of Anthropology, University of Hawai'i. Honolulu, Hawai'i. 2002-2009
 Professor, Department of Anthropology, University of Hawai'i. Honolulu, Hawai'i. 1994-2009
 Associate Professor, Department of Anthropology, University of Hawai'i. Honolulu, Hawai'i. 1990-1994
 Chair, Department of Anthropology, University of Hawai'i. Honolulu, Hawai'i. 2001-2002
 Professor, Department of Ecology and Health, John A. Burns School of Medicine (JABSOM), University of Hawai'i. Honolulu. 2001-2009
 Professor, Graduate Program in Ecology, Evolution and Conservation Biology, University of Hawai'i. Honolulu, Hawai'i. 2001-2009

Graduate Faculty, Department of Public Health, JABSOM, University of Hawai'i. 1994-2009
 Graduate Faculty, Program on Population Studies, University of Hawai'i. 1994-2009
 Researcher, Social Science Research Institute, University of Hawai'i. Honolulu, Hawai'i. 1990-2009
 Scientific Advisory Committee, Clinical Research Center, University of Hawai'i. 2001-2005.
 Associate Faculty, Public Policy Center, University of Hawai'i. Honolulu, Hawai'i. 2003-2009.
 Associate Professor, Department of Anthropology, University of Minnesota. Minneapolis, Minnesota. 1983-1990
 Assistant Professor, Department of Anthropology, University of Minnesota. Minneapolis, Minnesota. 1979-1983
 Visiting Professor, Department of Pharmacognosy and Drug Development, Ahmadu Bello University. Zaria, Nigeria. 1987-1988
 Adjunct Professor, Department of Afro-American and African Studies, University of Minnesota. Minneapolis, Minnesota. 1979-1990
 Assistant Professor, Department of Anthropology, and African Studies Advisor, University of Memphis. Memphis, Tennessee. 1977-1979
 Instructor of Anthropology. Department of Social Sciences, Webster College. Webster Groves, Missouri. 1972
 Graduate Teaching Assistant, Department of Anthropology, Washington University. St. Louis, Missouri. 1970-1973

Research Program

The Environment of Healing/Cultural Ecology of Clinical Encounters: health disparities, developing cultural competency. 2001-2009
 Local Knowledge and Resource Management: Building Iterative and Communicative Processes into Policy Decisions about Important and Invasive Plant Species in Hawai'i. 2002-2009
 Integrative (Complementary and Alternative/CAM) Medicines: prevention and treatment in the "informal sector" in contemporary Hawai'i – cultural constructions of healing, commodification of health and healing, physiological interactions between CAM and between CAM and pharmaceuticals, ethics, implications for clinic policy. 1990-2009
 Ethnomedicine in Eastern Indonesia: indigenous and western medicines in transition. 1990-1994
 Health and therapeutics among Hausa in Nigeria: cultural constructions of Hausa medicine; indigenous medicines and diet; impact on indigenous therapeutics of introduced biomedicines. 1975-2009
 Southeast Asian (Hmong) immigrants encounter the prenatal, biomedical clinic. 1984-1990
 Red blood cell studies in hypertension: population and individual differences in cation permeability and pathophysiology. 1980-1984
 Evolutionary significance of ABO blood groups: relation to infectious diseases. 1983-1985
 Laboratory and population studies of hemoglobin S (sickle cell anemia) and malaria infection. 1980-1990
 AIDS: behavioral correlates of transmission and prodromal syndromes. 1983-1985
 Diet among African Americans in Memphis, Tennessee. 1978-1980
 Post-doctoral field research in northern Nigeria: indigenous medicine in Hausa society; cultural constructions of health and therapeutics; food and health; pharmacologic analysis of medicinal and dietary flora; time allocation studies; dietary surveys. 1975-1976
 Laboratory Scientist, Department of Medicine, University of Minnesota Medical School: malaria infection and G6PD deficiency, hemoglobin S, and other red cell disorders of evolutionary significance. 1973-1975
 Research Assistant, Department of Anthropology, Washington University, St. Louis, Missouri: red blood cell metabolism; — regulators of glycolysis and redox status, G6PD deficiency, catalase and oxidation; inherited deficiencies of alpha-1-antitrypsin – relationship to infectious diseases and atherosclerosis. 1971-1972
 Research Assistant, Dept of Anatomy and Physiology, Indiana Univ. Bloomington, Indiana. 1969-1970

GRANTS/AWARDS: National/International Funding Agencies

1995: National Endowment for the Humanities. "The Transformation of Indigenous Medicines in Eastern Indonesia" (\$2700)
 1994-95: National Geographical Society (5255-94). "Migration and Ethnomedical Transitions in Maluku, Indonesia" (\$2600)
 1994-95: Shaman Pharmaceuticals. "Ethnomedicine and Ethnopharmacology in Maluku, Indonesia" (\$2600)
 1993-97: National Science Foundation (DBS-9221266) "Use of Plant Medicines by Contemporary Native Hawaiians" (\$90, 214)
 1987-90: National Science Foundation (BNS-8703734). "Health in Rural Nigeria: Pharmacology of Indigenous Plant Medicines" (\$150,891)
 1987-88: Social Science Research Council (and the American Council of Learned Societies). "Health Behavior in Rural Northern Nigeria: Indigenous and Western Medicines in Transition" (\$11,600)
 1987-88: Fulbright Senior Research Scholar Award. "Health in Rural Northern Nigeria" (\$24,000)
 1988-89: Bush Foundation Grant. "Health in Rural Northern Nigeria" (\$16,000)

1987-89 Howe Memorial Foundation. "Hmong Reproductive Behavior and Perinatal Health" (co-PI) (\$80,000)
 1981-83 American Heart Association – National Association, and Montana and Wyoming Affiliates (AHA 81-715). "Altered Red Cell Cation Transport in Hypertensive States" (\$23,710)
 1981-82 National Institutes of Health (HL-19877). "Prevention of High Blood Pressure in Children" (co-Investigator) (\$1,659,950)
 1971-72 National Science Foundation Graduate Fellowship
 1968-70 Undergraduate Merit Scholarships

GRANTS/AWARDS: *Competitive University Sources*

2006: University of Hawai'i Research Council. International Congress of Ethnopharmacology. Nanning, Guangxi Province, China. 22-26 August.
 2005: University of Hawai'i Research Council. International Conference on the Modernization of Chinese Medicine. Chengdu, Sichuan Province, China. (travel)
 2005: University of Hawai'i Research Council. International Congress of Ethnobotany: At the Junction of the Continents and the Disciplines. Istanbul, Turkey. (travel-declined)
 2003: University of Hawai'i Research Council. Joint meeting of the International Society for Ethnopharmacology and the South African Assoc of Botanists. Pretoria, South Africa. (travel-declined)
 2001: Research Corporation of Hawai'i, Excellence in Research Recognition Award (\$5000)
 2001: University of Hawai'i Research Council. American Anthropological Association. Washington DC. (travel)
 2000: University Research Council, University of Hawai'i. Joint Meeting of the International Society for Ethnopharmacology and the European Society for Medicinal Plant Research. Zurich, Switzerland. (travel)
 1999: University Research Council, University of Hawai'i. International Symposium on Ethnobotany. San José, Costa Rica. (travel)
 1998: University Research Council, University of Hawai'i. American Anthropological Association. Philadelphia. (travel)
 1998: University Research Council, University of Hawaii. International Conference on Anthropology and the History of Health and Illness. Genoa, Italy. (travel)
 1996: University Research Council, University of Hawai'i. Joint Meeting of the International Society for Ethnopharmacology and The Society for Economic Botany. London. (travel)
 1992-93: Research Corporation University of Hawai'i (RCUH) "Health and Healing in the Informal Sector: Use of Plant Medicines by Populations in Contemporary Hawai'i" (\$14,000)
 1990-93: College of Social Sciences, University of Hawai'i. "Laboratory Assessment of Medicinal Plants" (\$26,888)
 1993: President's Fund, University of Hawai'i. "Ethnopharmacology and Ethnomedicine" (\$700)
 1993: University Research Council, University of Hawai'i. African Studies Association. Boston. (travel - declined)
 1992: Center for SE Asian Studies, University of Hawai'i. "Indigenous Medicines in Maluku, Indonesia" (\$1100)
 1992: University Research Council, University of Hawai'i. International Congress of Ethnopharmacology. Uppsala, Sweden. (travel)
 1990-94: Research Support, Social Science Research Institute, University of Hawai'i. "Health and Healing in the Informal Sector: Use of Plant Medicines by Populations in Contemporary Hawai'i" (salary)
 1991: President's Fund, University of Hawai'i. "Social and Cultural Aspects of Pharmaceuticals" (\$1720)
 1991: University of Hawai'i College of Social Sciences. "The Pharmacology of Food and Medicine" (salary)
 1991: University Research Council, University of Hawai'i. Annual Meeting of the American Anthropological Association. Chicago. (travel)
 1990: University Research Council, University of Hawai'i. Annual Meetings of the American Anthropological Association. New Orleans. (travel)
 1989-90: University of Minnesota. "Medicinal Plants in Nigeria: the Pharmacology of Healing" (\$8,334)
 1989: College of Liberal Arts, University of Minnesota. "Infant Mortality in Hausaland" (\$400)
 1988-89: Sabbatical Leave, University of Minnesota. "Indigenous and Western Medicines in Transition in Northern Nigeria." (salary)
 1987-88: College of Liberal Arts, University of Minnesota. "Medical Transition in Rural Nigeria." (\$1000)
 1987-88: International Programs, University of Minnesota. "Indigenous and Western Medicines in Transition in Nigeria." (\$800)
 1986-87 Grant-in-Aid of Research, University of Minnesota. "Hmong Health Care and Pregnancy Outcome." (\$4,000)
 1985: Single Quarter Research Leave, University of Minnesota. "Evolutionary Significance of ABO Blood Groups: Adaptation to Infectious Disease." (salary)
 1984: Research Appointment, University of Minnesota. "Sickle Hemoglobin: Molecular Basis of Antimalarial Effect." (salary)

1984-85: Grant-in-Aid of Research, University of Minnesota. "Plants, Diet, and Medicine: A Bio-Behavioral Perspective." (\$7,000)
 1984-90: Grant-in-Aid of Research, University of Minnesota. "Computer Applications in Journal Editing." (\$5120)
 1981: University of Minnesota Medical School. "Cellular Cation Transport in Essential Hypertension." (salary)
 1979-1989: University of Minnesota. Each year, Annual Meetings of the American Anthropological Association. (travel)
 1978: Research Appointment, Memphis State University. "Folk Medicine: Bio-Anthropological Approaches." (salary)
 1970-73: Graduate Assistantships, Washington University, St. Louis, Missouri.

HONORS, EDITORIAL POSITIONS, AND ADVISORY BOARD AFFILIATIONS

2001: University of Hawai'i Regents' Medal for Excellence in Research.
 2007: Scientific Committee, International Society of Ethnopharmacology, São Paulo, Brazil (2008)
 2006: Scientific Committee, International Congress of Ethnobotany, San Carlos de Bariloche, Patagonia, Argentina (2009).
 2006: Vice Chair of Academic Committee, International Congress of Ethnopharmacology, Nanning, Guangxi Province, China.
 From 2004: Honorary Board Member of the International Society of Ethnopharmacology, as a scholar of highest international stature.
 2004-2005: Scientific Advisory Board, International Congress of Ethnobotany (ICEB), Istanbul.
 2004: Scientific Committee, joint meeting of the International Society for Ethnopharmacology, the International Society for Ethnobiology, and the Society for Economic Botany. Kent, England.
 2003-2009: Editorial Board Member, *Journal of Complementary and Integrative Medicine (JICM)—An International Forum for Evidence-Based Practice* (www.bepress.com/jcim)
 2003-2009: Editorial Board Member, *Ethnobotany Research and Applications*
 2003: Vice Chair, Scientific Committee, International Symposium on New Achievements in Natural and Traditional Medicine. Beijing, China.
 2003: Scientific Committee, joint meeting of the International Society for Ethnopharmacology and the South African Association of Botanists. Bridging the Gap between Traditional Knowledge and Sustainable Development. Pretoria, South Africa.
 2002: Official Delegate to the Opening Ceremony of the China Beijing International High-Tech Expo, Great Hall of the People; joined a small group of dignitaries received by Zhu Rongji, Premier of China.
 2002-2009: Scientific Advisory Committee for the Clinical Research Center, a part of the National Institutes of Health Program on Research Centers in Minority Institutions
 2001-2009: Panel of Experts for Review of the National Institutes of Health (NIH)/Fogarty International Cooperative Biodiversity Groups (ICBG) Grants
 2001-2009: Review Panel, National Science Foundation, Grants in Aid of Graduate Studies
 2008-2009: Editorial Board, *Pharmaceutical Biology*
 2001-2008: Associate Editor, *Pharmaceutical Biology*
 2001: Scientific Committee, International Congress of Ethnobotany: Ethnobotany in the Third Millennium: Expectations and Unresolved Issues. Naples, Italy
 2001: Scientific Committee, International Symposium on Ethnobotany, Ethnomedicine, and Pharmacology. Antigua, Guatemala
 2001: Co-Chair, Scientific Committee, International Symposium on Lycium and Antiaging Agents. Yinchuan, Ningxia, China
 2001-2009: Editorial Board Member, *International Journal of Tropical Medicinal Plants*
 2000: Scientific Committee, joint meeting of the International Society for Ethnopharmacology, and the European Society for Medicinal Plant Research. Zurich, Switzerland
 2000-2002: Past President, International Society for Ethnopharmacology
 1999-2009: Scientific Staff, Museum of Ethnomedicine, University of Genoa, Italy
 1999: Scientific Committee, International Symposium on Ethnobotany, University of La Paz, San José, Costa Rica
 1998-2001: Member, Scientific Committee for the conference Building Bridges. Honolulu, Hawai'i
 1998-2009: Editorial Board Member, *University of Vienna Institute of Medicine Newsletter*
 1997-2009: Editorial Board Member, *SOMA: Interactions Therapeutiques et Anthropologie Médicale*
 1997-2002: Editorial Board Member, *American Anthropologist*
 1996-97: Excellence in Teaching Award, College of Social Sciences
 1996-2000: President, International Society for Ethnopharmacology
 1996-2009: Fellow, The Linnean Society
 1984-99: Editor-in-Chief of the journal *Reviews in Anthropology*

1996-2009: Editorial Board Member, *Anthropology and Medicine*
 1996-2009: Editorial Board Member, *Journal of Ethnopharmacology*
 1996-2009: Editorial Board Member, *Journal of Ethnobiology*
 1990-2009: Member, Scientific Committee for the International Congress on Ethnopharmacology.
 1994-2009: Member, Scientific Committee, European Colloquium on Ethnopharmacology
 1995-2009: Member, Scientific Committee for the International Conference on Anthropology and the History of Health and Disease. Genoa, Italy
 1999-2008: Editorial Board Member, *Reviews in Anthropology*
 1991-94: Editorial Board Member, *Medical Anthropology Quarterly*
 1991-2009: Board Member, International Society for the Study of Social and Cultural Aspects of Pharmaceuticals
 1990-2004: Board Member and U.S.A. Representative for the International Society of Ethnopharmacology
 1990-92: Advisory Committee, American Association for the Advancement of Science (AAAS) Malaria in Sub-Saharan Africa Project
 1990-93: Chair, Nominations Committee. Council for Nutritional Anthropology
 1989-92: Africa Advisory Committee for Fulbright Senior Scholars Awards and the Council for International Exchange of Scholars
 1979: Special Editor of the journal *Medical Anthropology*
 From 1969: Phi Beta Kappa

PROFESSIONAL CONFERENCES AND PRESENTATIONS (all refereed or by special invitation)

2009: **Etkin, N.L.** Ethnography and Ecology in Theory-Driven, Integrated Field Methodologies. Invited Plenary Address. International Congress of Ethnobotany. La Plata, Argentina. 21-24 September
 2009: **Etkin, N.L.** Pharmaceuticals and Folk Traditions in Hawai'i: Polypharmacy in Contested Narratives of "Noncompliance." Invited Plenary Address. 50th Anniversary Meeting of the American Society of Pharmacognosy. Honolulu, Hawai'i. 27 June - 1 July.
 2008: **Etkin, N.L.** The Indigenization of Pharmaceuticals and the Mediation of Side Effects. Invited Keynote Address. International Congress of Ethnopharmacology. São Paulo, Brazil. 16-19 September.
 2006: **Etkin, N.L.** Edible Medicines: The Intersection of Food, Life Narratives, and Health. Presented to the Center for Biographical Research. University of Hawai'i. Honolulu. 28 September
 2006: **Etkin, N.L.** Taking the Tradition out of Traditional Medicines: Globalization and Natural Health Products. Invited Plenary Address. International Congress of Ethnopharmacology. Nanning, Guangxi Province, China. 22-26 August.
 2005: **Etkin, N.L.** "Acculturation" and Health Disparities Research. Presented to the Clinical Research Seminar. JABSOM/University of Hawai'i Medical School. Honolulu, HI. 13 October.
 2005: **Etkin, N.L.** Panel Executive Co-Chair. "Sustainable Development and Utilization of TCM Resources. International Conference on the Modernization of Chinese Medicine. Chengdu, Sichuan Province, China. 25-27 September.
 2005: **Etkin, N.L.** The Emperor Has no Clothes: "Acculturation" and Health Disparities Research. Presented to the Community Pediatrics Research Seminar. Kapi'olani Medical Center. Honolulu, HI. 7 September.
 2005: **Etkin, N.L.** Research Progress for Sustaining TCM in 21st Century USA. International Conference on the Modernization of Chinese Medicine. Chengdu, Sichuan Province, China. 25-27 September.
 2005: **Etkin, N.L.** Symposium Organizer. "Ethnobotanical Studies of Wild Plant Foods." Presented as an Invited Session to the International Congress of Ethnobotany. Istanbul, Turkey. 21-26 August.
 2005: **Etkin, N.L.** Wild Plant Management in Rural Hausaland: Local Ecological Knowledge Contributes to the Conservation of Biodiversity. International Congress of Ethnobotany. Istanbul, Turkey. 21-26 August.
 2005: **Etkin, N.L.** More than Microbes: Cultural Constructions and Social Negotiations of Re-Emergent Infections. Invited Plenary Address. Emerging Infectious Disease and Socioecological Systems. John A. Burns School of Medicine and the East-West Center. Honolulu, Hawai'i. 9-11 March.
 2004: **Etkin, N.L.** Traditional Ecological Knowledge and the Conservation of Botanical Diversity in Northern Nigeria. Presented to the University of Hawai'i Department of Botany. 7 April.
 2004: **Etkin, N.L.** Polypharmacy in Contested Narratives of "Noncompliance." Critical Theory, Urgent Issues, Advocacy. Joint Meeting of the Society for Medical Anthropology and the Society for Applied Anthropology. Dallas, Texas. 31 March - 4 April.
 2004: **Etkin, N.L.** and S.E. Edwards. Workshop on Ethnographic Data Collection and Management. Joint Meeting of the International Society for Ethnobiology, International Society of Ethnopharmacology, and the Society for Economic Botany. Kent, England. 14-18 June
 2004: **Etkin, N.L.** Polypharmacy: Rethinking the Cultural Construction and Social Negotiation of Multiple Medicines. Joint Meeting of the International Societies for Ethnobiology and Ethnopharmacology, and the Society for Economic Botany. Kent, England. 14-18 June

- 2003: **Etkin, N.L.** Ethnography of Foraging, Phytofoods, and Fermentation. International Conference on the Anthropology of Food. International Commission for the Anthropology of Food (ICAF). International Union of Ethnological and Anthropological Sciences (IUEAS). Poysdorf, Austria : 4-7 December.
- 2003: **Etkin, N.L.** Biocultural Approaches in Health Research: Ethnographic Methods for Developing Cultural Competence. Invited In-Service Presented to the Department of Pediatrics Kapi'olani Medical Center. Honolulu, Hawai'i. 17 September.
- 2003: **Etkin, N.L.** The Co-evolution of People, Plants, and Parasites: Implications for the Conservation of Biodiversity. Presented to the University of Georgia Department of Anthropology. 10 January.
- 2003: **Etkin, N.L.** Benefit-Sharing (BS?): Hype or Hope? Invited Plenary Address. International Conference on Medicinal Plants: Access, Use and Benefit Sharing in the Light of the Convention on Biological Diversity. Oslo, Norway. 3-5 April.
- 2003: **Etkin, N.L.** Ethnopharmacology and Biodiversity. Invited Plenary Address. Joint Conference of the International Society for Ethnopharmacology and the South African Association of Botanists. University of Pretoria. Pretoria, South Africa. 7-11 January.
- 2002: **Etkin, N.L.** The Co-evolution of People, Plants, and Parasites: Biological and Cultural Adaptations to Malaria. Invited Lecture. Biomedical Research Seminar. University of Hawai'i. Hilo, Hawai'i. 26 November
- 2002: **Etkin, N.L.** The Role of Nutraceuticals in Health Care. Invited Plenary Address. World Ayurveda Congress. Kochi-Kerala, India. 1-4 November.
- 2002: **Etkin, N.L.** and H.L. McMillen. The Ethnobotany of Noni: Dwelling in the Land between La'au Lapa'au and TestiNONials. Invited Plenary Address. Hawai'i Noni (*Morinda citrifolia*) Conference. Hilo, Hawai'i. 26-27 October.
- 2002: **Etkin, N.L.** Population, Ecology, Health: Biocultural Perspectives on the Interrelations between People and Environment. Invited Faculty Seminar. Population Studies Program. University of Hawai'i. Honolulu, Hawai'i. 14 October.
- 2002: **Etkin, N.L.** Eco-Health Series: The Cultural Ecology of Clinical Encounters. Department of Medicine Grand Rounds, Queen's Hospital/University of Hawai'i. Honolulu, Hawai'i. 3 September.
- 2002: **Etkin, N.L.** Ethnopharmacology: Exploring the Co-Evolution of People, Plants, Herbivores, and Their Respective Pathogens. Invited Plenary Address. Nutrition Society Conference: The Food Chain – Plants, Animals, Man. Leeds, England. 2-5 July.
- 2002: **Etkin, N.L.** Creating Links between Bioscience and Traditional Empirical Knowledge. Invited Plenary Address. World Congress of Pharmacology. San Francisco, California. 7-12 July.
- 2002: **Etkin, N.L.** CAM Use among Cancer Patients: Invited Plenary Address. International Symposium on Integrated Treatment for Cancer. Honolulu, Hawai'i. 29-30 June.
- 2002: **Etkin, N.L.** CAM Research in Honolulu: beyond Catalogues of "How Many?" and "Who Uses What?" Invited Plenary Address. "Conference on the Future of CAM Research and Education in Hawai'i. Honolulu, Hawai'i. 25-26 June.
- 2002: **Etkin, N.L.** Contributions of Traditional Knowledge and Practices to the Conservation of Biodiversity. Invited Plenary Address. International Conference on Science and Technology in Biodiversity Conservation and Utilization. Beijing, China. 22-24 May .
- 2002: **Etkin, N.L.** and P.J. Ross. Polypharmacy and the Elderly Cancer Patient: Rethinking "Noncompliance." Invited Magisterial (Plenary) Address. International Conference on Ethnogerontology & Ethnogeriatrics: Living and Healing Old Age in the World. Genoa, Italy. 11-16 March.
- 2001: **Etkin, N.L.** One Hundred Years of Paradigmatic Shifts in the Bioscience of Food: Implications for the Anthropology of Diet and Health. Presented at the 100th Annual Meeting of the American Anthropological Association in the Council on Nutritional Anthropology sponsored session "Plus ça Change: Shift and Stasis in the Anthropology of Food and Diet." Washington DC. 28 November - 2 December.
- 2001: **Etkin, N.L.** Learning How to Learn Cultural Issues: Implications for Health Care Practice, Research, and Policy. Cultural Sensitivity Training Workshop/Inservice. Presented to Hawai'i Biodyne. Honolulu, Hawai'i. 10 December.
- 2001: **Etkin, N.L.** Cultural Issues in Health Care: Implications for Process and Policy. Inservice. Presented to the Hawai'i Medical Service Association (HMSA) Care Management Department. Honolulu, Hawai'i. 25 October.
- 2001: **Etkin, N.L.** The Future of Ethnobotany: Moving Fast, Going Where? Invited Plenary Address. International Congress of Ethnobotany: Ethnobotany in the Third Millennium: Expectations and Unresolved Issues. Naples, Italy. 22-30 September.
- 2001: **Etkin, N.L.** Complementary and Alternative Medicine (CAM): "Folk Medicine" of the Early 21st Century in the West. Invited Senior Magisterial Dissertation (Plenary Address). International Symposium on Ethnobotany, Ethnomedicine, and Pharmacology. Antigua, Guatemala. 14-18 September.
- 2001: **Etkin, N.L.** Nutraceuticals, Cosmeceuticals, and Antiaging Agents in US Popular Culture. Invited Plenary Address. International Symposium on Lycium and Antiaging Agents. Yinchuan City, Ningxia Hui Autonomous Region, China. 6-9 August.

- 2001: **Etkin, N.L.** Symposium Organizer. "Ethnopharmacology: Building Bridges between Natural Products Chemistry and Traditional Knowledge." Presented as an Invited Session to the Building Bridges Conference. Honolulu, Hawai'i. 28 May - 2 June.
- 2001: **Etkin, N.L.**, P.J. Ross, A. Funahashi, J.N. Busch, and J.D. Baker. Ethnopharmacology: Building Bridges to Where? Presented to the Building Bridges Conference, as part of the Invited Session "Ethnopharmacology: Building Bridges between Natural Products Chemistry and Traditional Knowledge." Honolulu, Hawai'i. 28 May - 2 June.
- 2001: **Etkin, N.L.** Invited Specialist for Lecture Series in "Advanced Ethnobotany." University of Hawai'i. Honolulu, Hawai'i. 2-6 June.
- 2001: **Etkin, N.L.** The Co-Evolution of People, Plants, and Parasites: Biological and Cultural Adaptations to Malaria. Presented to the Faculty of the Ecology, Evolution, and Conservation Biology Program (EECB). University of Hawai'i. Honolulu, Hawai'i. 27 April.
- 2000: **Etkin, N.L.** The Co-evolution of People, Plants, and Parasites: Biological and Cultural Adaptations to Malaria. Annual Meeting of the American Anthropological Association. San Francisco, California. 15-19 November.
- 2000: Moerman, D.E. and **N.L. Etkin**, Symposium Co-Chairs. Ethnobotany Goes Public: "Herbal" Medicines in an Anthropological Context. Annual Meeting of the American Anthropological Association. San Francisco, California. 15-19 November.
- 2000: **Etkin, N.L.** Perspectives in Ethnopharmacology: Forging a Closer Link between Bioscience and Traditional Empirical Knowledge. Invited Keynote Address. Joint meeting of the International Society for Ethnopharmacology and the European Society for Medicinal Plant Research. Zurich, Switzerland. 3-7 September.
- 1999: **Etkin, N.L.** Ethnomedical Approaches to the Study of Indigenous Antimalarials: Prevention and Treatment. Invited Keynote Addresses. WHO Research Initiative on Traditional Antimalarials. Moshi, Tanzania. 8-13 December.
- 1999: **Etkin, N.L.** From Crabs to Oncogenes: The Cultural Construction of Cancer in the U.S. Presented to Oncology Staff at St. Francis Medical Center as a component of the Hawai'i Nurses' Association Continuing Education Program. Honolulu, Hawai'i. 23 November.
- 1999: **Etkin, N.L.** The Ethnopharmacology of Fermented Medicinal Foods. Magisterial Dissertation (Keynote Plenary Address). International Symposium on Ethnobotany. San José, Costa Rica. 14-18 September.
- 1998: **Etkin, N.L.** and P.R. Ross. Local Knowledge of Biotic Diversity and its Conservation in Rural Hausaland (Nigeria). 97th Annual Meeting of the American Anthropological Association. Philadelphia, Pennsylvania. 2-6 December.
- 1998: **Etkin, N.L.** Complementary ("Alternative") Therapies. Invited Address. Clinical Trials Update Meeting. Cancer Research Center of Hawai'i. Honolulu, Hawai'i. 13 October.
- 1998: **Etkin, N.L.** Antimalarial Plants: Co-evolutionary Dimensions of Human Biology and Culture, Botanicals, and Infectious Disease. Invited Keynote Address. European Congress on Tropical Medicine and Meeting of the Royal Society of Tropical Medicine and Hygiene. Liverpool, England. 14-18 September.
- 1998: Ross, P.R. and **N.L. Etkin**. Alternative/Complementary Cancer Therapies. Invited Address. Oncology Nursing Conference "Cancer Care; Hitting the High Notes." Honolulu, Hawai'i. 21 August.
- 1998: **Etkin, N.L.**, A.R. Dixon, P.W. Nishimoto, and P.J. Ross. Medicinal Foods in Multiethnic Honolulu, Hawai'i. Invited Plenary Address. International Conference on Anthropology and the History of Health and Illness. Genoa, Italy. 2-5 April.
- 1997: **Etkin, N.L.** Protecting Habitats for Medicinal Plants and Local Populations. Invited Plenary Address. International Symposium on Herbal Medicine. Honolulu, Hawai'i. 1-4 June.
- 1996: **Etkin, N.L.** Biocultural Perspectives on Health in a Hausa Village in Northern Nigeria: Linking the Ethnography of Illness to the Pharmacological Action of Plant Medicines. Department of Anthropology, Northwestern University. Evanston, Illinois. 18 November.
- 1996: **Etkin, N.L.** Nutrition and Health in African Societies. Invited Faculty Seminar. Population Studies Program. University of Hawai'i. Honolulu, Hawai'i. 26 September.
- 1996: **Etkin, N.L.** and T. Johns. "Pharmafoods" and "Nutraceuticals:" Paradigm Shifts in Biotherapeutics. Medicines and Foods. Invited Keynote Address. Joint Meeting of the International Society for Ethnopharmacology, and the Society for Economic Botany. London. 1-6 July.
- 1996: **Etkin, N.L.** and P.J. Ross Reframing Studies of Plant Medicines. Invited Plenary Address. European Colloquium on Ethnopharmacology, and the International Conference on Anthropology and the History of Health and Disease. Genoa, Italy. 29 May - 2 June.
- 1995: **Etkin, N.L.** The Rational Basis of "Irrational" Drug Use: Pharmaceuticals in the Context of "Development." International Institute and School of Pharmacy, University of Michigan. Ann Arbor. 24 October.

- 1995: **Etkin, N.L.** Medical Anthropology – Bridging the Social Sciences and the Professional Schools of Medicine, Pharmacy, and Public Health. International Institute, University of Michigan, Ann Arbor. 25 October.
- 1995: **Etkin, N.L.** Plants as Antimalarial Drugs: Relation to G6PD Deficiency and Evolutionary Implications. Invited Plenary Address. International Symposium on G6PD Deficiency: Evidence for Adaptation and Health Consequences. Cortona, Italy. 3-5 July.
- 1995: **Etkin, N.L.** Antimalarials of Plant Origin. Invited Plenary Address. Presented as part of the symposium “Biochemical Co-Evolution: Some Evolutionary Implications.” Annual Meeting of the Society for Economic Botany. Ithaca, New York. 21-25 June.
- 1995: **Etkin, N.L.** Medicinal Cuisines: Diet and Ethnopharmacology. Invited Plenary Address. Functional Foods for Health Symposium. University of Illinois. Chicago, Illinois. 22-24 May.
- 1995: A.R. Dixon, **N.L. Etkin**, and P. Nishimoto. Preliminary Findings on the Current Use of Complementary Medicine among Hawaii's Residents. Invited Plenary Address. E Ola Mau Symposium “Health and Healing: Ancient Traditions in a Modern World.” Wai’anae, Hawai’i. 31 March - 1 April.
- 1995: **Etkin, N.L.** The Pharmacologic Implications of Conserving Biodiversity through Indigenous Models of Plant Utilization. Annual Conference of the Society of Ethnobiology. Tucson, Arizona. 15-18 March.
- 1994: **Etkin, N.L.** Making Sense of the Therapeutic Jungle. Presented to the 93rd Annual Meeting of the American Anthropological Association, Invited Discussion for the session “Culture, Perception, and the Environment.” Atlanta, Georgia. 30 November - 4 December.
- 1994: **Etkin, N.L.** The Pharmacologic Implications of Conserving Biodiversity through Indigenous Models of Plant Utilization. Invited Keynote Plenary Address. Third International Congress on Ethnopharmacology. Beijing, China. 6-10 September.
- 1994: Dixon, A.R. and **N.L. Etkin**. Health and Healing in the Informal Sector of Medicine. Conference on Health Care in the Twenty-First Century: Implications for Nursing Practice and Research. Honolulu, Hawai’i. 9 September.
- 1993: **Etkin, N.L.** The Flexible Forest: Ethnopharmacologic Perspectives on Diet and Medicine. Plenary Address. Colloque Européen d’Ethnopharmacologie, and la Conférence Internationale d’Ethnomédecine. Heidelberg, Germany. 24-27 March.
- 1992: **Etkin, N.L.** and F. Hopkins. Contemporary Uses of Medicinal Plants in Hawai’i. Annual Meetings of the Society for Economic Botany and the American Institutes of Biological Sciences (AIBS). Honolulu, Hawai’i. 9-13 August.
- 1992: **Etkin, N.L.** A Multicontextual Framework for Assessing the Health Significance of Human-Plant Interactions. National Symposium on People-Plant Relationships: Setting Research Priorities. Newark, New Jersey. 24-26 April.
- 1992: **Etkin, N.L.** Anthropological Methods in Ethnopharmacology. Keynote Plenary Address. Second International Congress on Ethnopharmacology. Uppsala, Sweden. 2-4 July.
- 1991: **Etkin, N.L.** Symposium Organizer. “Eating on the Wild Side: The Pharmacologic, Ecologic, and Social Implications of Using Noncultigens.” Council on Nutritional Anthropology Invited Session to the 90th Annual Meeting of the American Anthropological Association. Chicago, Illinois. 20-24 November.
- 1991: **Etkin, N.L.** and P.J. Ross. Pharmacologic Implications of “Wild” Plants in Hausa (Nigeria) Diet and Therapeutics. 90th Annual Meeting of the American Anthropological Association, as part of the Invited Session “Eating on the Wild Side” sponsored by the Council on Nutritional Anthropology. Chicago, Illinois. 20-24 November.
- 1991: Ross, P.J. and **N.L. Etkin**. A Changing Hausa Diet: Digesting a Perspective on Disease Adaptation. 90th Annual Meeting of the American Anthropological Association, as part of the Invited Session “Thinking About Eating” sponsored by the Archaeology Division. Chicago, Illinois. 20-24 November.
- 1991: **Etkin, N.L.** The Problem of “Side Effects” in Planning Better-Informed Use of Pharmaceuticals. International Conference on Social and Cultural Aspects of Pharmaceuticals. Amsterdam, The Netherlands. 17-21 October.
- 1991: **Etkin, N.L.** The Behavioral Dimensions of Malaria Control: Guidelines for Culturally Sensitive and Microecologically Germane Policies. American Association for the Advancement of Science (AAAS) Conference “Malaria in Sub-Saharan Africa: A Cross-Sectoral Approach.” Mombasa, Kenya. 24-28 May.
- 1991: **Etkin, N.L.** and B. A. Meilleur. Ethnomedicine in Polynesia: Past Trends and Future Directions. XVII Pacific Science Congress. Honolulu, Hawai’i. 27 May - 2 June.
- 1990: AAAS Malaria in Africa Project Advisory Committee Meeting and Workshop. Washington, D.C. 13-20 September, 6-11 November.
- 1990: **Etkin, N.L.** and P.J. Ross. Domestic Risk Factors in Diseases of Childhood in Northern Nigeria. 89th Annual Meeting of the American Anthropological Association, as part of the Invited Session “Household Ecology of Disease Transmission,” sponsored by the Society for Medical Anthropology. New Orleans, Louisiana. 27 November - 1 December.

- 1990: **Etkin, N.L.** Diet and Ethnopharmacology. Invited Keynote Plenary Address. International Congress on Ethnopharmacology. Strasbourg, France. 5-9 June.
- 1990: **Etkin, N.L.** Methodologic Questions in Medical Anthropology Research: Approaching the Community. School of Public Health. University of Minnesota Medical School. Minneapolis, Minnesota. 12 April.
- 1990: **Etkin, N.L.** Bio-Behavioral Perspectives in Medical Anthropology. Department of Anthropology. University of Minnesota. Minneapolis, Minnesota. 27 February.
- 1990: **Etkin, N.L.** Evaluating Efficacy: Indigenous Medicines in Nigeria. Humanistic Health Forum. University of Minnesota Medical School. Minneapolis, Minnesota. 6 February.
- 1989: **Etkin, N.L.** and P.J. Ross. The Greater Risk of Fewer Deaths: An Approach to Infant Mortality in Hausaland. 88th Annual Meeting of the American Anthropological Association, as part of the Invited Session "Infant Morbidity and Mortality: Relationships to Fertility" sponsored by the Biological Anthropology Section. Washington D.C. 15-19 November.
- 1989: **Etkin, N.L.** Pharmaceuticals and Plant Medicines in Nigeria. University of Maryland Department of Anthropology. College Park, Maryland. 29 March.
- 1989: **Etkin, N.L.** Plants and Pills: The Dynamics of a West African Medical System. University of Hawai'i. Honolulu, Hawai'i. 2 March.
- 1988: **Etkin, N.L.**, P.J. Ross, and I. Muazzamu. The Indigenization of Pharmaceuticals: Therapeutic Innovations in Rural Hausaland. 87th Annual Meeting of the American Anthropological Association. Phoenix, Arizona. 16-20 November.
- 1988: **Etkin, N.L.**, P.J. Ross, and I. Muazzamu. Indigenous Medicine and Biomedicine in Transition: A Study in Rural Northern Nigeria. 31st Annual Meeting of the African Studies Association. Chicago, Illinois. 28-31 October.
- 1988: **Etkin, N.L.** Traditional Medicine and Traditional Diseases: A Framework for the Evaluation of a Hausa Herbal Pharmacopoeia. Keynote Address. Annual Meeting of the Nigerian Society of Pharmacognosy. Zaria, Nigeria. 8 January.
- 1987: **Etkin, N.L.** Anthropological Perspectives on Health. Multi-Disciplinary Forum on Health. School of Nursing. University of Minnesota. Minneapolis, Minnesota. 11 February.
- 1987: **Etkin, N.L.** Food as Medicine and Medicine as Food. Carlton College. Northfield, Minnesota. 21 May.
- 1987: **Etkin, N.L.** Anthropologic Approaches to Cross-Cultural Health Issues. School of Public Health, University of Minnesota Medical School. Minneapolis, Minnesota. 16 April.
- 1986: **Etkin, N.L.** Medicinal Food and Nutritious Medicine: Implications for Health. Food and Values Conference. Hamline University. St. Paul, Minnesota. 11 June.
- 1986: **Etkin, N.L.** Medical Anthropology and Its Relation to Public Health. School of Public Health. University of Minnesota Medical School. Minneapolis, Minnesota. 17 April.
- 1986: **Etkin, N.L.** Processual Healing and Cultural Constructions of Efficacy. Department of Anthropology, Northwestern University. Evanston, Illinois. 28 April.
- 1986: **Etkin, N.L.** Cultural Interpretations of Health. Presentation and Workshop for "First Do No Harm: A Symposium on Preventive Medicine." School of Medicine, University of Minnesota. Minneapolis, Minnesota. 3 May.
- 1983: **Etkin, N.L.** and J.W. Eaton. Blood Bankers, Viruses, and ABO Blood Groups. 52nd Annual Meeting of the American Association of Physical Anthropologists. Indianapolis, Indiana. 6-9 April.
- 1983: **Etkin, N.L.**, J.W. Eaton, O. Gomez-Marin, R. Prineas, and R. Gillum. Red Cell Permeability and Blood Pressure: the Minneapolis Children's Blood Pressure Study. 23rd Annual Conference on Cardiovascular Disease Epidemiology. Dallas, Texas. 3-5 March.
- 1983: Ross, P.J. and **N.L. Etkin.** How Can You Be in All Places at Once When You're Not Anywhere At All? Time Allocation Research and Fieldwork in Northern Nigeria. Workshop: Annual University of Minnesota Anthropology Conference. Woodbury, Minnesota. 20-22 May.
- 1982: Mahoney, J.R., **N.L. Etkin**, J.D. McSwigan, and J.W. Eaton. Abnormal Red Cell Sodium Transport in Essential Hypertension. Annual Meeting of the Academy of Clinical Laboratory Physicians and Scientists. Seattle, Washington. 23-25 June.
- 1982: **Etkin, N.L.**, J.R. Mahoney, J.D. McSwigan, and J.W. Eaton. Altered Erythrocyte Sodium Transport in Essential Hypertension. 51st Annual Meeting of the American Association of Physical Anthropologists. Eugene, Oregon. 31 March - 3 April.
- 1981: **Etkin, N.L.** Nutritional Anthropology: Research Questions and Methodologic Implications. Biomedical Anthropology Colloquium. University of Minnesota. Minneapolis, Minnesota. 11 February.
- 1981: **Etkin, N.L.** and P.J. Ross. Food as Medicine and Medicine as Food: An Adaptive Model for the Interpretation of Plant Utilization among the Hausa of northern Nigeria. Annual Ethnobiology Conference. Columbia, Missouri. 13-14 March.
- 1981: **Etkin, N.L.**, J.R. Mahoney, and J.W. Eaton. Hemoglobin S: Molecular Basis for Antimalarial Effect. 50th Annual Meeting of the American Association of Physical Anthropologists. Detroit, MI. 22-25 April.

- 1981: Mahoney, J.R., **N.L. Etkin**, J.D. McSwigan, and J.W. Eaton. Abnormal Red Cell Cation Permeability in Essential Hypertension. Annual Meeting of the American Society of Hematology. San Antonio, Texas. 5-8 December.
- 1980: **Etkin, N.L.** Biochemical Evaluation of Indigenous Medicines. Department of Social and Administrative Pharmacy, University of Minnesota School of Pharmacy. Minneapolis, Minnesota. 10 March.
- 1979: **Etkin, N.L.** and P.J. Ross. Indigenous Medicine, Diet, and Malaria among Hausa of Nigeria. 78th Annual Meeting of the American Anthropological Association. Cincinnati, Ohio. 27 November - 1 December.
- 1980: **Etkin, N.L.** Biocultural Issues in Medical Anthropology. University of North Dakota. Grand Forks, North Dakota. 11 April.
- 1979: **Etkin, N.L.** Bio-behavioral Studies in Medical Anthropology and Public Health. School of Public Health and Department of Pediatrics, University of Minnesota. Minneapolis, Minnesota. 15 November.
- 1979: **Etkin, N.L.** Factors Influencing Diet and Nutrition in Developing Countries: A Case Study among the Hausa. Keynote Address. Memphis District Dietetic Association Meetings. Memphis, TN. 10 April.
- 1979: **Etkin, N.L.** and P.J. Ross. Disease, Nutrition, and Indigenous Medicine. 22nd Annual Meeting of the African Studies Association. Los Angeles, California. 31 October - 3 November.
- 1979: **Etkin, N.L.** Symposium Organizer, Empirical Methods in the Evaluation of Indigenous Medical Systems: Cross-Cultural Comparisons. Invited Session for the 14th Annual Meeting of the Southern Anthropological Society. Memphis, Tennessee. 22-24 February.
- 1979: **Etkin, N.L.** An Indigenous Medical System among Hausa of Northern Nigeria: Laboratory Evaluation for Potential Therapeutic Efficacy of Antimalarial Plant Medicinals. Annual Meeting of the Southern Anthropological Society. Memphis, Tennessee. 22-24 February.
- 1978: **Etkin, N.L.** Empirical Evaluation of Hausa Medicinal Flora. 47th Annual Meeting of the American Association of Physical Anthropologists. Toronto, Canada. 12-15 April.
- 1974: **Etkin, N.L.** and J.W. Eaton. Malaria-Induced Erythrocyte Oxidant Sensitivity. International Conference on Red Cell Metabolism and Function. Ann Arbor, Michigan. 16-19 October.
- 1974: **Etkin, N.L.** and J.W. Eaton. Selective Advantage of Glucose-6-Phosphate Dehydrogenase Deficiency: the Biochemical Basis. 43rd Annual Meeting of the American Association of the American Association of Physical Anthropologists. Amherst, Massachusetts. 10-13 April.
- 1972: **Etkin, N.L.** and J.W. Eaton. Glucose-6-Phosphate Dehydrogenase Deficiency: Mode of Protection against Fulminant Malaria Infection. 71st Annual Meeting of the American Anthropological Association. Toronto, Canada. 20-26 November.
- 1972: Eaton, J.W., M. Boraas, and **N.L. Etkin**. Catalase Activity and Red Cell Metabolism. International Conference on Red Cell Metabolism and Function. Ann Arbor, Michigan. 27-29 April.

GOVERNANCE/LEADERSHIP/PROFESSIONAL SERVICE

Nina Etkin directed the University of Hawai'i Medical Anthropology Program and participated as well in curriculum, research, and advising in the Cultural, Ecological, and Biological Anthropology concentrations. She served in 2001-2002 as Department Chair, and since 2002 as Graduate Chair. On another level, she has participated in university-wide governance through the activities of the following committees, on each of which she served an average of 2 years; Graduate Council; Tenure and Promotion Review Committee; Gender and Ethnic Minority Faculty Equity Review Panel; Committee for PhD Proposal in Food and Environmental Sciences; Planning Committee, Program on Human Biology; School of Medicine Basic Sciences Committee; University Program Review Committee; Committee on Human Subjects in Research; and the Arts and Sciences Faculty Executive Committee. Similarly, Nina Etkin has served the UH College of Social Sciences through the Social Sciences Research Council; Social Science, Health, & Medicine Certificate Program Committee; and CSS Program Review Committee.

Each year Nina Etkin reviewed 20-25 manuscripts for *Social Science and Medicine*; *Medical Anthropology*; *American Anthropologist*; *Africa*; *Economic Botany*; *Human Biology*; *Medical Anthropology Quarterly*; *Journal of Laboratory and Clinical Medicine*; *Journal of Ethnobiology*; *Ecology of Food and Nutrition*; *Journal of Ethnopharmacology*; *Pharmaceutical Biology*; *Folklore*, and others; 4 book manuscripts for major university presses and other academic publishers; 8-10 grants for the National Science Foundation, Social Science Research Council, National Institutes of Health, National Geographic Society, and others.

MEMBERSHIP IN PROFESSIONAL SOCIETIES

International Society of Ethnopharmacology
American Association for the Advancement of Science
Fellow, The Linnean Society
Society for Medical Anthropology
Human Biology Association

Society for Economic Botany
Austrian Society for Ethnomedicine
Health Action International
International Health & Infectious Diseases
Ame Assoc of Biological Anthropologists

Society of Ethnobiology
 American Society of Pharmacognosy
 International Council on Social and
 Cultural Aspects of Pharmaceuticals
 Society for Anthro of Food and Nutrition

American Anthropological Association
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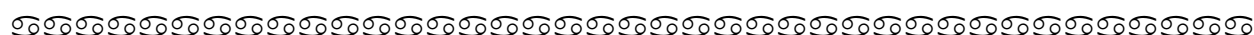
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Perspective paper

Seeking a transdisciplinary and culturally germane science: The future of ethnopharmacology

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Abstract

Publication of the 100th issue of the *Journal of Ethnopharmacology* offers a strategic juncture to reflect on what, intellectually and practically, substantiates ethnopharmacology as a domain of inquiry and what its future might be. We characterize ethnopharmacology through the diversity of its practitioners, and review critiques that challenge researchers to set their sights on a theory-driven and context-sensitive study of the pharmacologic potential of species used by indigenous peoples for medicine, food, and other purposes. The conclusion suggests themes that will inspire an integrated, transdisciplinary ethnopharmacology for the future.

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Keywords: Transdisciplinary research; Anthropology; Ethnography; Botany; Pharmacology

1. Introduction: defining ethnopharmacology

Publication of the 100th issue of the *Journal of Ethnopharmacology* (JEP) offers a strategic juncture to reflect on what, intellectually and practically, substantiates ethnopharmacology as a domain of inquiry and what its future might be. By one, compelling logic, ethno- (Gr., culture or people) pharmacology (Gr., drug) is about the intersection of medical ethnography and the biology of therapeutic action, i.e., a transdisciplinary exploration that spans the biological and social sciences. This suggests that ethnopharmacologists are professionally cross-trained – for example, in pharmacology and anthropology – or that ethnopharmacological research is the product of collaborations among individuals whose formal training includes two or more traditional disciplines. In fact, very little of what is published as ethnopharmacology meets these criteria.

A primary difficulty in defining and projecting a future for ethnopharmacology is to identify the objectives of a largely virtual field whose self-identified membership represents, in

addition to commercial entities, a diverse suite of academic and applied disciplines. Departments or degree-granting programs designated specifically as ethnopharmacology do not exist, it is primarily represented by published investigators trained in pharmacology, anthropology, botany, and pharmacognosy. Contributions are made as well by historians of science, clinicians, ethnographers, agronomists, biochemists, researchers in veterinary medicine, and others. This multi- (but not trans) disciplinarity has challenged efforts to harmonize objectives and integrate methodologies (Elisabetsky, 1986; Prinz, 1990; Etkin, 1996, 2001; Etkin and Ross, 1991, 1997). For the future, one would hope that the multivocality of the various disciplines that contribute to ethnopharmacology will create a dynamic tension that encourages dialogue and collaboration.

The present discussion is part of that dialogue and projects the perspective on ethnopharmacology that was articulated in the formation of the International Society for Ethnopharmacology (ISE), and reinforced in the objectives of its official journal. The *Journal of Ethnopharmacology* JEP was inaugurated in 1979 with a statement of mission that defined ethnopharmacology as “a multidisciplinary area of research concerned with the observation, description, and

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experimental investigation of indigenous drugs and their biological activity” (Rivier and Bruhn, 1979). The description of scope emphasized the balance and breadth of disciplinary representation across a range of natural and social sciences:

The Journal of Ethnopharmacology will publish original articles concerned with the observation and experimental investigation of the biological activities of plant and animal substances used in the traditional medicines of past and present cultures. The journal will particularly welcome interdisciplinary papers with an ethnopharmacological, an ethnobotanical, or an ethnochemical approach to the study of indigenous drugs. Reports of anthropological and ethnobotanical field studies fall within the journal’s scope. Studies involving pharmacological and toxicological mechanisms of action are especially welcome. (*JEP* Frontmatter)

2. Objectives of ethnopharmacology research

Mission statement notwithstanding, during the first 2 decades of its existence most of the articles published in the *JEP* were not interdisciplinary. Two retrospective content analyses of the journal revealed for the periods 1979–1996 and 1996–2000 an increasing number of articles dedicated exclusively or primarily to pharmacology and pharmacognosy. More significant to the present discussion is the consistently small number of multi- or interdisciplinary articles, 4–6% of the total published (Etkin and Ross, 1991, 1997; Etkin, 2001). In view of the highly skewed over-representation of pharmacology and pharmacognosy in the contents, one could argue that the *JEP* failed to establish the unique position it sought among natural products journals. Privileging bioscientific ideologies reproduces a Euro-American tradition that discounts traditional ways of knowing and managing resources, i.e., this conveys the idea that medicines become meaningful only when validated by pharmacologic inquiry. In an integrated ethnopharmacology of the future, bioscience should be only one of several lenses through which to understand how people manage health.

3. Critical reviews and challenges for an integrated ethnopharmacology

In the last 15 years, critical reviews of the field of ethnopharmacology challenged researchers to strive for a more holistic, theory-driven, and culture- and context-sensitive study of the pharmacologic potential of (largely botanical) species used by indigenous peoples for medicine, food, and other purposes (Elisabetsky, 1991; Balick et al., 1996; Svarstad and Dhillon, 2000; Etkin, 2001; Heinrich and Gibbons, 2001; Laird, 2002; Stepp et al., 2002). The foundation of these critiques is that much of what is reported as ethnopharmacological research is comprised by decontext-

tualized catalogues of plants and lists of phytoconstituents and/or pharmacologic properties. While this work is technically competent bioscience that provides foundational data, it lacks synthesis—only a very small percentage of ethnopharmacology researchers reflect on the range of botanicals, the environments from which they are drawn, and the diverse chemistries they embody. Also, there is little incremental growth of knowledge within and beyond this corpus of evidence. Intellectually and substantively, each study is a stand-alone. Many laboratories are satisfied to report the results of the 15 or 20 species examined and then, rather than build on that knowledge, test the therapeutic potential of another group of plants against the same, or even a different, biological target. Few researchers in ethnopharmacology seem to be interested in the people whose knowledge and identity are embodied in these plants (Elisabetsky and Nunes, 1990). While some studies are based on plants drawn from indigenous pharmacopoeias, most of what is published as ethnopharmacology has a weak, if any, ethnographic component. While laboratory-exclusive studies provide valuable baseline data, they disappoint from the standpoints of both practice and theory—few researchers seek to make order of the iterative lists of active plants and their constituents, and fewer still offer theoretical advances (Elisabetsky, 2002). Further, only a small number of these studies offer insights into the experience of real people in specific cultural and eco-political settings, or project the findings against some higher level of abstraction that helps us to understand human–plant interactions (Elisabetsky and Setzer, 1985).

On the basis of these critiques, as well as deliberations within and outside the ISE, in 2001, the *JEP* Board issued a revised mission statement to underscore the importance of integrated, theory- and issue-driven research in ethnopharmacology:

The Journal of Ethnopharmacology publishes original articles concerned with the observation and experimental investigation of the biological activities of plant and animal substances used in the traditional medicine of past and present cultures. The journal will particularly welcome interdisciplinary papers with an ethnopharmacological, an ethnobotanical or an ethnochemical approach to the study of indigenous drugs. Reports of anthropological and ethnobotanical field studies fall within the journal’s scope. Studies involving pharmacological and toxicological mechanisms of action are especially welcome. Clinical studies on efficacy will be considered if contributing to the understanding of specific ethnopharmacological problems. The journal also welcomes review articles in the above mentioned fields especially on novel methodologies relevant to disease states. (*JEP* Frontmatter)

An editorial by the ISE President at that time (Heinrich, 2001) stressed the importance of addressing the social and political implications of research design and application, especially for indigenous peoples whose knowledge and resources have been appropriated in the course of natural

products development, which largely benefits the West. It was further emphasized that ethnopharmacology research should be understood within the broader context of biodiversity conservation, sustainable resource management, and intellectual and biological property rights. This revised statement better reflects contemporary circumstances and globalization processes in which indigenous people's ideologies and material cultures become increasingly commoditized and politicized on a scale of global proportions. This broad, integrated vision of ethnopharmacology has substantial potential for scholarly and practical advances in the next decades. It remains to be seen whether this is a mandate that will shape research into the future, or whether – as has occurred in the past – this statement resonates the collective culture of the ISE, but not necessarily the individuals who identify themselves as ethnopharmacologists.

4. Future trends

Although the critiques did not find or forge a shared vision for the intellectual and substantive content of ethnopharmacology, they did identify several trends that help project a future ethnopharmacology.

- Advances in laboratory and clinical sciences will continue, allowing ethnopharmacologists to characterize to a greater level of specificity: the constituents and activities of medicinal plants (and other substances); how variations in the collection and storage of plants, and the preparation and administration of medicines, affects pharmacologic profiles; interactions among constituents of single- and multiple-species medicinal preparations, and between traditional plant medicines and both pharmaceutical drugs and complementary and alternative medicines.
- More comprehensive analysis will address the effects of ingesting phytochemicals in the maintenance/improvement of body functions and/or disease prevention. Such analysis may lead to observations that substantiate the dietary proscriptions and prescriptions that characterize some indigenous medical systems. It has been argued that the rapid acceptance and commercialization of nutraceuticals reflects a return to earlier health paradigms in which little distinction was made between food and medicine.
- Dosage schedules for indigenous medicines will require clarification. Some traditional formulations (like some pharmaceuticals) are prescribed for substantial duration with no significant improvement expected for weeks or months. In view of the relatively low level of active constituents per dose of plant material, and the mode of preparation for home medicines, one might argue that traditional therapies involve the regular ingestion of low doses of active substance(s) over a significant period of time.
- In pharmacodynamic terms, it is likely that this pattern of disease intervention may be profoundly different from an acute (single administration) or sub-chronic (a few administrations) challenge to any given molecular target. Nevertheless, traditional posology has rarely been taken into account in evaluating medicinal plant extracts or substances in new drug screening/development programs. Lack of information on the details of traditional use is in part related to practical matters: a research design that measures the effects of repeated interaction with tissues and/or molecular targets requires large quantities of testing materials. In vitro methodologies are, unfortunately, inadequate for these purposes. Nevertheless, the consequences of constant and repeated challenges to molecular targets will need to be taken into consideration at least in interpreting results, especially if the objective is an analysis integrated with results from in vivo models and traditional claims.
- Application of the rigorous ethnographic field methodologies refined over the last several decades will continue to improve our comprehension of the cultural construction and social transaction of healing in diverse cultures. An integrated, theory- and issue-driven ethnopharmacology will move from multidisciplinary (parallel streams lacking integration), to interdisciplinary (some methodological and theoretical exchange across disciplines), to transdisciplinary methodologies that integrate the perspectives, objectives, and tools of diverse disciplines.
- Ecological factors will receive more attention as researchers understand that resource management strategies are based in part on micro- and landscape-level features, such as topography, soil composition, canopy cover, UV radiation, rainfall, and the proximity of other plant and animal species. Because each of these features, and their combinations, can influence both phytochemistry and the ideational aspects of plants (the meaning of color, growth form, etc.) they influence when, which, and where to collect/cultivate medicinal plants.
- Drug discovery from natural products will remain an important goal for some ethnopharmacologists, with the understanding that pharmaceutical advances in this area have the potential to improve health in all world cultures.
- Increasingly in the future ethnopharmacologists will have to respect and interact with national and local governments, as well as with the growing number and diversity of entities that have evolved over the last 10–15 years as indigenous groups have formalized their sociopolitical circumstances through local, national, and global representations. These interactions should be participatory collaborations that involve local peoples in all phases of research.
- The existing, and future iterations of the U.N. Convention on Biological Diversity and other ethical issues will guide ethnopharmacology research design and application. The extension to indigenous peoples of

intellectual property rights will continue to be complex, contentious, and politically nuanced. It will involve people and entities whose perceptions of, and access to, authority and resources is not equal. Issues of benefit sharing become increasingly abstract and, despite the growing magnitude of the literature on benefit sharing, the breadth of debate has contracted to center primarily on commercial bilateral contractual agreements, despite that most of the resources whose benefits could be shared are not amenable to those legal covenants. Further, many constituencies are excluded from such bilateral contractual benefit sharing, e.g., countries and communities who could impart the same knowledge or resources.

9. In view of the obstacles described above, and to broaden our knowledge base, the trend will continue to base more ethnopharmacology research in traditional pharmacopoeia of the West, as well as in botanicals marketed as complementary and alternative medicines and supplements. At the same time, attracted by the commercial success in the West, countries of the developing world will try to develop Western-like plant medicines based on local medicinal flora. One advantage of this trend is that such efforts stimulate the development of evidence-based new botanical medicines, with the requisite local development of all the necessary disciplines. A disadvantage is to standardize traditional medicines for the sake of marketing, obscuring the diversity of ways that botanicals are used by traditional peoples.
10. At the same time, ethnopharmacologists will strive harder in the future to connect to issues of social, as well as phytochemical and clinical, salience by assuring that the results of rigorous bioassays and medical ethnography be translated, integrated, and applied to the indigenous contexts in which people use those plants. Ethnopharmacology can contribute to the exploration of phytotherapeutical resources for use in the local contexts and countries of origin. Even where biomedicine is a significant primary care modality, local botanicals can be integrated into holistic health care settings that encourage sustainable resource management through medicinal plant gardens and home-based or cottage-industry preparation of botanical medicines.
11. Perhaps, the most demanding work for the future will be to build theoretical capacity in ethnopharmacology. To date, only a handful of researchers have contributed to this development, exploring such issues as:
 - a. How local environmental knowledge both undergirds and emerges from co-evolutionary people–plant–landscape relations.
 - b. How the apprehension and management of resources is culturally constructed and socially transacted in

ways that influence knowledge asymmetries and health disparities.

- c. How the multicontextual use of plants (in medicine, food, cosmetics, etc.) impacts health, as well as the conservation of cultural and biological diversify.

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Indigenous patterns of conserving biodiversity: pharmacologic implications

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Abstract

The accelerating rate at which the world's botanical resources are being depleted today has inspired redoubled efforts on the part of global conservation programs. For the most part, this reflects the actions of outsiders who are culturally and politically detached from the threatened environments, and who identify species for conservation through western economic models. In view of this, ethnopharmacologists—and primarily those representing the social sciences—have drawn attention to the cogency of indigenous knowledge of biotic diversity and its conservation. This paper reviews how local paradigms of plant management promote conservation, and problematizes the issue specifically to the use of plants by Hausa peoples in northern Nigeria. The pharmacologic implications of indigenous patterns of plant use and conservation derive from the manifold and overlapping contexts in which plants, especially wild species, are used by local communities. These applications identify the importance of particular species and should be employed in assigning priority for the conservation of plants. © 1998 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Biodiversity; Nigeria; Hausa; Indigenous conservation; Local populations

1. Introduction

The speed with which the earth's genetic resources are being depleted today threatens species extinction of a magnitude unparalleled in human history.

The most widely accepted estimate by the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wide Fund for Nature (WWF) is that 60000 higher plant species could become extinct or near extinct by the middle of the next century if present trends continue. This exceeds... [nearly 3-fold] earlier estimates... which were based mainly on experience in temperate countries...

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The primary cause of this loss will be the continuing destruction of the habitats that support these species... Probably the most daunting aspect of the biodiversity issue is our almost complete ignorance of both the problem itself and potential benefits that may be lost or retained. (Principe, 1991)

This is most apparent in areas experiencing rapid socioeconomic transition, especially where western technology is brought suddenly to bear on traditional societies and where global market forces encourage greater homogeneity both of the environment and of the products of human labor—including the plants that local communities produce.

While the preservation of species is being debated from a variety of western postures, predominantly economics, the significance of those taxa has not been properly assessed in the cultural and ecological contexts of their use. Instead, species designated for conservation have been identified by outsiders who are culturally and politically detached from the threatened environments. In view of this, ethnopharmacologists—primarily those representing the social sciences—have drawn attention to the cogency of indigenous knowledge of biotic diversity and its conservation.

Global efforts to sustain biodiversity will be better served by paying close attention to the variety of species used by local populations, especially wild plants, and to the full range of their uses. This paper reviews how local paradigms of plant use and conservation can inform conservation efforts. Examples from the literature are reviewed, and the issue is problematized further to the use of plants by Hausa in northern Nigeria.

Local communities most removed from the global market have customarily been regarded as places where traditional cultures persist—where one can learn a variety of applications for the local flora, ranging among medicines, foods, cosmetics, and others. More recently these communities have come to be appreciated as repositories not only of knowledge but also of biological diversity itself.

With uneven success, international agencies also have entered into the fray. Justifying their

self-empowerment to act among indigenous communities, these coalitions cite the limitations of community conservation efforts. They note, for example, that the magnitude of what local groups can accomplish is small compared to what a timber industry or commercial agricultural firms might do. Certainly this is true, but local efforts have an overall greater potential for success because they are precisely that—local. They represent intimate knowledge of the native ecology and have long experience with the species in question. Where international initiatives fail, this can inevitably be linked in some way to the fact that they have not engaged the local community in their efforts. Many of these programs are unsuccessful because they are based in land use patterns that do not correspond to local land tenure systems. They also fault community conservation efforts because their scope is relatively limited, reflecting their own subsistence and utilitarian needs rather than the broader vision of wildlife biologists. Further,

current global conservation proposals... assume a priori that conservation must take place within a neutral, all-encompassing social matrix consisting of the expanding global market economy, existing relations of state-village authority, and official national development programs.... In short that 'conservation can be regarded as a form of economic development' provided for 'through appropriate policies from the central government'. Think tanks in the US and Europe... produce books on how to persuade governments and local people to 'recognize' the value of biodiversity by looking into its economics. (Lohmann, 1991)

The idea that biodiversity is already valued, or that local communities can play an important role in conservation efforts does not enter the debate. Instead, indigenous peoples are regarded not as active agents, but as auxiliaries whose 'co-operation' is sought and for whom the outsiders must furnish 'tools'. Traditional knowledge is not viewed as a means to effect conservation in the local context, but as 'raw material' that will be transformed into something that is 'useful' to

development planners and managers of biological resources (Lohmann, 1991).

The last four decades of worldwide ‘development’ efforts witnessed many cases in which state and international agencies initiated forest management schemes for logging, construction of hydroelectric dams, land conversion for monocropping of cash crops, development of tourism infrastructure, and related activities. In the face of local resistance to many of these projects, ‘development’ planners have caricatured indigenous peoples as generically opposed to innovation. But knowledge of indigenous cultures reveals their actions more accurately as expressions of concern about the erosion of biological diversity that typically attends ‘development’ projects—concern about threats to the cultural and physical environment, including habitat destruction and increasingly limited access to local flora and fauna. Similarly, experience confirms that local populations are wise to be wary of conservation schemes that have been designed by outsiders, whose vision of what should be conserved is different from that of the local communities. This underscores that, contrary to what many ‘development’ strategists believe, indigenous peoples are intimately familiar with their environments, comprehend the consequences of diminished biodiversity, and have developed strategies for both anticipating and preventing it. What are these strategies?

2. Traditional models of conservation

Human management of forest and other landscapes can be traced far back into history, predating incipient agriculture by millennia. Paleobotanical research in New Guinea, for example, reveals 30000–40000-year-old evidence that forest trees were thinned and pollarded to enhance development of natural stands of yam (*Dioscorea* spp., Dioscoreaceae), banana (*Musa* spp., Musaceae), and taro (*Colocasia* spp., Araceae) (Hladik et al., 1993, in Wiersum, 1997). Beginning with the most subtle of interactions, the co-evolution of human and plants has eventuated in a range of expressions that reflect the selection

of particular species and their manipulation in myriad ways to assure their conservation.

At present, conservation strategies are of two fundamental types, which have different implications for the local communities who use the resident species—in situ (in-habitat) and ex situ (out-of-habitat). The objective of in situ conservation is to assure that land use of the sites (e.g. agroforestry) is restricted to activities that do not imperil habitat conservation and that target species regenerate with no, or only short-term, human management. Most significant for the present discussion is that for in situ conservation, all growth phases of the target species are maintained within the ecosystem in which they originally evolved (National Research Council, 1991). A corollary of this is that in situ conservation transpires within the same sociocultural system in which people first recognized those plants and where they continue to exploit them for diverse uses. Where government- and commercially-planned in situ conservation differs from its local counterpart is that it almost always involves one or a few species per land area. This is significantly unlike the complex, mixed-species environments that are managed by indigenous peoples.

The second type, ex situ conservation, refers to strategies that conserve genetic material outside the natural distribution of the parent population; this can involve using reproductive material from individuals or stands from outside the locus of the parent population. The methods of ex situ conservation include breeding populations, living stands, gene banks, short-term collections, and arboreta (National Research Council, 1991).

I review a few examples to illustrate how indigenous populations mix these two strategies:

A classic anthropological study of Lua’ agriculture in northwestern Thailand revealed how swiddening, or slash and burn cultivation, created species-rich transitional zones. This involved extensive knowledge of local ecology and the management of a mix of micro-habitats:

swiddens: cut, burned and cultivated on a regular rotation cycle;

irrigated fields: cleared, leveled, plowed and harrowed, flooded during the cultivation of wet rice and baked... [hard] in the hot season;

village gardens: lining the streams in the dry season, carefully fenced, leveled and watered to produce vegetables;
 the village itself: swept clean, frequently grazed over..., with fruit trees and other useful plants...;
 fish ponds: dug near water courses... and stocked with fish... and... a water-growing vegetable;
 streambeds: ...[where] several species are planted or gathered;
 and old and uncut forests... in which gathering is permitted, but cutting of trees prohibited. (Kunstadter, 1978)

This systematic modification resulted in a complex anthropogenic environment that was even more botanically diverse than would have existed 'naturally', illustrating that this population recognized and used more features of the environment than what swiddeners are typically credited with (managed burning for land clearing and staple crop cultivation in the swiddens).

Similarly, Balée and Gély (1989) describe managed forest succession by the Ka'apor in Amazonia. Much more than a 'culture of the forest', these swidden horticulturists both exploit primary forest and manage domesticated and semi-domesticated plants and animals in the diverse vegetational zones that are created as a result of their own activities in this forest. The principal zones are distinguished by age, extent of management, indicator species and other in situ indicators, and the primary activities that people engage within the area. These include house garden, young and old swiddens, fallow, mature forest, and swamp forest; ecotones (transitional zones) are distinguished between garden and swidden and swidden and forest, and between unmanaged areas. This broad, integrated system of forest management sustains the serviceability of the local environment in a way that primary forest could not.

In Java, substantial species diversity, including varietal divergence, has been recorded in home gardens that include perennials and annuals ranging from ground creepers to 25-m tall trees. Fish ponds often are incorporated into these gardens to create complex, integrated agro-ecosystems (Soemarwoto et al., 1985). Likewise, small mixed

forest gardens in highland Sri Lanka bear high tree density (350–500 individuals/ha) and include 25–35 woody species (Everett, 1995). And in Tanzania, Johns et al. (1996) describe traditional agropastoralists who combine elaborate stream-fed, irrigation with gathering to manage 44 wild and 35 cultivated species that serve dietary, medicinal, and other purposes.

One could continue in this vein, with more illustrations of culturally constructed, utility-based conservation that is achieved through habitat regulation (other interesting examples are offered by, Altieri, 1993; Arizpe et al., 1996; Brush and Stabinsky, 1996; Carter et al., 1995; Gautier, 1996; Nazarea-Sandoval, 1995; Oldfield and Alcorne, 1991; Schelhas and Greenburg, 1996; Vickers, 1984; Western et al., 1994; Wiersum, 1997). My point in offering these examples is that these actions are deliberate, they are effective, and they are instructive. These and similar studies show that few indigenous peoples are resource foragers; most are resource managers (Balée, 1989). And it is precisely their intimate knowledge of local microecologies that equips them for success.

3. The conservation of biodiversity in Nigeria

I turn attention now to Nigeria, Africa's most populous nation, where the need to preserve biodiversity is especially conspicuous. In this very large country, much of the 92.3 million ha land area (Hyman, 1993) has (or until recently has had) extensive vegetation cover, which figures among the country's important natural renewable resources that require sustained management approaches to conservation (the others being marine and fisheries, water, wild animal, and soil resources).

3.1. Nigeria before the British occupation

In the late 1800s, the Kano Emirate in the northern savanna region of Nigeria was the 'heartland of the Sokoto Caliphate, the largest most complex, best organized, and richest state system in nineteenth-century West Africa' (Cline-Cole, 1994). The Close-Settled Zone (CSZ), a

concentration of rural population around Kano that has long experienced dense settlement and intensive cultivation, expanded from approximately 15 miles radius in 1870–1880 to more than 30 miles in the early 1900s (Cline-Cole, 1994).

Even after decades of expanded settlement and population growth, the early 20th century CSZ still was characterized by large expanses of uncultivated land dominated by perennial mesophytic grasses and fire-resistant trees and shrubs.

Precolonial land-use patterns in northern Nigeria contributed to an increasingly anthropogenic landscape in which dense and savanna shrub were replaced with managed and selectively wooded parkland dominated by trees and diverse herbaceous and shrub species that were used for medicine, food, construction, firewood, and other local applications. Although competition for natural resources increased, intensive agroforestry and restrictions on what resources the state could commandeer helped to maintain ecological stability. A traditional political hierarchy governed ownership and access to natural resources, with authority vested in supervisors of public lands: *Sarkin Hurumi* was responsible for adjudicating matters dealing with cattle paths, community grazing lands, cemeteries, and the like; hunting resources in the ‘bush/wild’ were the domain of *Sarkin Daji* (whose authority did not include flora); *Sarkin Ruwa* governed water resources; and land allocation was typically mediated by the Village or District Head (Cline-Cole, 1994).

Trees generally were tended, rather than planted, and were privately owned; tree tenure in most cases coincided with land tenure. Still today, individuals typically have standing permission to collect on private lands, provided that their need is compelling (e.g. for medicine) and that they do not over-collect. Plants growing in ‘bush’/wild areas (*daji*) are common property, thus less vulnerable to over-exploitation compared to free-access resources. The absence of tax on fuel wood and other forest/farm resources reduced pressure on the poor to over-exploit vegetation. Collectively, then, indigenous political economies shaped conservative resource management to serve societal priorities, which depended directly on local botanical resources.

3.2. Nigeria and British colonial rule

The colonial presence countermanded traditional authority over plant (and other) resources. The first colonial forestry legislation for northern Nigeria was the 1902 Protection of Trees Proclamation, the objective of which was to prevent the felling of what the British identified as ‘productive economic trees’ for fuelwood. Early colonial forestry policy was configured to generate revenue and sought to radically reform indigenous agroforestry practices, of which northern Nigeria’s first high commissioner (Frederick Lugard) was highly critical—although his knowledge of local practices was only cursory. Thus,

Colonial forestry policy... fail[ed] to distinguish clearly between sustainability problems inherent in the structure and functioning of precolonial agroforestry systems and problems that were a consequence of the breakdown of traditional checks on overexploitation. (Cline-Cole, 1994)

The 1902 policy had only minimal impact on the CSZ, which produced only ‘minor’ forest products for export, was home to none of the major regional forests, and was not physically occupied by the British until 1903. But the 1906 Forestry Proclamation had far greater implications for the CSZ: 150 tree species were designated as ‘protected’, requiring a license for harvest/collection; and fees were imposed for commercial exploitation. These regulations affected both on- and off-farm collection, and jeopardized the complex integrated subsistence systems that had evolved in the CSZ.

British policy also challenged the ‘holistic nature’ of local resource management by establishing distinct regional ministries for agriculture and forestry. Over the next 15 years taxes increased on land, craft production, and (potential, not actual) sylvan productivity (Cline-Cole, 1994). In the CSZ firewood traditionally was branched/small wood, the collection of which resulted in pollarding—which is sustainable, compared to felling trees for trunk wood, which does not conserve tree resources. As increasing taxes continued to pressure households, and the commercial value of

forest products (primarily firewood) rose, farmers pollarded more aggressively and felled more trees.

Nigeria's forestry law is essentially unchanged since a 1938 legislative act, and later local government (LG) reforms, established dual responsibility for individual states and their constituent LGs for the protection of trees and management of forest estate (Hyman, 1993). A key element of the government's policy was that higher priority was assigned to food production.

Whereas British forest policy projected reservation of 25% of Nigeria's forests, the colonial government did not reserve land for forestry in the CSZ until about 1915, and only 11% of Nigeria's total land area eventually was reserved as Forest Estate. Between 1940 and 1960 efforts to conserve through natural regeneration were unsuccessful, due to various factors, including the length of time required for seedlings to germinate, slow growth of established crops, and poor survival of species with low commercial value. Especially important has been the loss of forest and savanna vegetation to clear-felling for cash crops such as groundnuts (*Arachis hypogaea* L., Fabaceae), coffee (*Coffea*, spp., Rubiaceae), oil palm (*Elaeis guineensis* Jacq., Palmae) and cocoa (*Theobroma cacao* L., Sterculiaceae) (Osemeobo, 1993).

3.3. Nigeria after independence

Since Nigeria's independence in 1960, conservation policy has languished in the wake of administrative discontinuities, political instabilities, and a national economy besieged by a fluctuating world oil market. Each year, ca. 280000 hectares of unreserved closed forest are cleared, and approximately 26000 hectares of natural forest are cleared and replanted with primarily exotic, fast growing species (Hyman, 1993). Today less than 1% of the reserved forest land exists as inviolate natural reserve where human disturbance is strictly prohibited. These plots have been circumscribed within the constituted forest reserves to conserve representative samples of natural vegetation ecosystems. In other conserved areas, forestry services permit limited removal of plant and ani-

mal species. The objective of both the inviolate plots and those that undergo regulated exploitation is the maintenance of sustained yield.

As the Nigerian systems concerned with the management of biodiversity continued to deteriorate, conservation efforts increasingly took the form of ex situ management of a small number of indigenous and exotic species in plantation forestry (Kio and Gbile, 1992). High cost and slow growth in plantations contribute to the failure of artificial regeneration of wild plants, and plantations account for only 0.17% of land in northern Nigeria (Hyman, 1993).

Moreover, government and commercial plantations of monotypic stands do nothing to replicate natural contexts of plant growth and use. In fact, they threaten conservation efforts because such management concentrates on a small number of species, and is likely to lead to the disappearance of highly adapted plants that cannot survive outside their savanna and forest ecosystems (Kio and Gbile, 1992). My point is that conservation should be conceived not to protect resources from local populations, but to conserve biotic resources on the people's behalf, and in a way that is centered on indigenous categories of use.

3.4. Nigeria today

Projections for the future will remain bleak unless strategies and financial allocations shift. For example, in the last decade Nigeria has allocated funds insufficient to deal with even 1% of the land that is required for stabilization (Osemeobo, 1993). More germane are issues that bear on a larger vision. Nigeria continues to treat issues of biodiversity conservation largely as forestry, rather than agroforestry, revealing a fundamental disjunction between indigenous approaches and those typical of government, colonial, and commercial concerns worldwide. Agroforestry is an approach rather than a specific measure in itself. Rather than applying formulaic 'solutions', conservation must be organized on a case-by-case basis that identifies particular plant species, combinations, and management objectives for specific geographies and cultural groups.

In 1989 a National Policy on the Environment was issued (Hyman, 1993; Iwu, 1996) that reflects both Nigeria's position in the global economy and Nigerian scientists' increasingly sophisticated knowledge of problem and solution. Beyond identifying objectives—which will remain abstract and generic until applied to particular circumstances—the policy has not established a clear order of priority or quantitative parameters (e.g. time frame, expenditure, etc.). Still, it is encouraging that in Nigeria today national policy formally recognizes the value of preserving biodiversity, expanding and conserving forest reserves, and promoting research. Most germane for the present discussion are the beginnings of discussion to conserve species that are most salient for local communities.

3.5. Which species should be conserved?

A key feature of Nigeria's problems of vanishing species diversity is that information is inadequate regarding all but the most obvious and pervasive of plant use strategies. That is, outside of major food-, cash-, and timber-crops, little is known about how local peoples allocate land and conceive of and use their botanic resources (Chukwuma, 1994). Vital information on wild plants is especially deficient (Osemeobo, 1990, 1992, 1993; Etkin, 1994a; Etkin and Ross, 1994; Iwu, 1996), and the role that those species play vis-à-vis conservation efforts has been misinterpreted. For example, it has been argued that indigenous agricultural production is inconsistent with wild plant conservation and that local communities obstruct government conservation efforts because 'the use of wild plants in traditional medical practices... leads to indiscriminate exploitation of the plant resources' (Osemeobo, 1992). To the contrary, in this and other discussions (Etkin and Ross, 1994) we have demonstrated that it is precisely because local populations value plants for medicinal, cosmetic, and other uses that some measure of conservation is achieved.

Our research on plant use in a northern Nigerian Hausa village illustrates this better.

4. Conserving biodiversity in a Hausa village in northern Nigeria

Since the 1970s we have conducted extensive research on plant use, land management, and health in a Hausa-Fulani community located 50 km southeast of Kano. The village core of Hurumi is a nucleated settlement of 400 residents; dispersed compounds in the outlying hamlets raise the population total to approximately 4000. The size of compounds in this rural settlement ranges from two to 40 occupants, who customarily include a compound head, his wife (or wives), his sons and their wives, and children. Hurumi's economy centers on intensive agriculture supplemented by livestock raising (primarily sheep, goat, and fowl; some cattle) and trade in locally produced and imported commodities. Although clearly less remote today than during our initial investigation in the 1970s, the village still is not served by paved roads and has neither electricity nor piped water; the greater part of subsistence labor—from planting through harvest, supplemented by gathering in the 'wild'—is neither mechanized nor assisted by draft animals. (For recent discussions of the larger research program, study site and methodology, consult Ross et al. (1996) and Etkin and Ross (1997)).

The combination of dense settlement, intensive cultivation, and low rainfall in the Kano CSZ has contributed to a breakdown of biomass formation with subsequent loss of species. Yet despite longstanding pressures toward biotic simplification, Hausa today still select from among a large number of domesticated and semi-wild local species for food, medicine, and other uses. Their use of plants in these overlapping contexts has helped to slow the erosion of biodiversity.

4.1. Hausa land use

Hausa farming is a small-holder occupation in which individually owned plots are cultivated on a strictly seasonal schedule configured by a short rainy season of about 3-months duration. The major food crops are bulrush millets (*Pennisetum* spp., Poaceae; *gero*, *maiwa*), guinea corn (*Sorghum* spp., Poaceae; *dawa*), groundnut (*Arachis*

hypogaea L., Fabaceae; *gyada*), cowpea (*Vigna unguiculata* Walpers, Fabaceae; *wake*), and cassava (*Manihot esculenta* Crantz, Euphorbiaceae; *rogo*). The variety of diet is greatly amplified by a large number of semi-wild plants that flavor, garnish, extend, and highlight these bulk carbohydrates and legumes (Etkin and Ross, 1994).

4.1.1. Gardens

Residents of the nucleated settlement have great difficulty maintaining within-compound gardens because it is almost impossible to protect plants from the livestock that are housed within (day and night during the rainy season, for the night during the dry season). Some individuals isolate small cultivation areas close to their compounds, variably planting medicinal species, culinary flavorings, and others; these require additional labor to provide water and protective fencing (especially during the dry season when livestock range beyond the confines of residential compounds during the day). On an irregular basis, trees are planted for shade and for medicinal and other utilitarian purposes. For the first several years of growth these require constant attention for watering and protection against livestock. These managed areas account for only a fraction of the plants used, and contribute relatively little to conserving biodiversity in this location (perhaps with the exception of *Azadirachta indica*, discussed below).

On the other hand, plots in the seasonally flooded river bank gardens (3 km from the village center) are managed year-round by human powered (and more recently generator-assisted) irrigation. In great variety, individuals cultivate vegetables, medicines, and other useful species, and experiment with new species for urban markets.

4.1.2. Farm borders

A large proportion of local floral diversity is contained within farm borders, the 1–2 m-wide strips that demarcate the numerous small plots cultivated by villagers. Here, one finds a great variety of ‘semi-wild’ plants—that is, plants neither explicitly cultivated nor actively tended, but nevertheless affected by human management

strategies. The significance of these plants generally is represented by these figures: of the 264 locally growing plants used as medicine, 89% (235) are ‘semi-wild’ and embody significant diversity in both species and pharmacology; only 11% (29) of local medicinals are cultivated. Semi-wild plants from farm borders are employed across the range of locally designated uses—for example, medicinal, cosmetic, and other purposes. Sixteen per cent of the semi-wild medicinals used locally are extracted from farm borders (Etkin and Ross, 1994).

Another 27% of the semi-wild medicinals are extracted from public lands (Etkin and Ross, 1994). These common areas include the borders of some of the larger paths that link human activities (e.g. between hamlets) and support year-round vegetative cover that is botanically heterogeneous. Other public land is contained within cattle paths; in earlier times these were more or less the exclusive domain of nomadic Fulani herders, and still provide never-cultivated, public access where foliage remains through both rainy and dry seasons. These paths spill intermittently into small open patches that farmers neglect because of the sandy soil, but that still support sufficient vegetation for grazing cattle. One would have anticipated this extent of diversity in the mixed-vegetation farm borders and public lands.

4.1.3. Farms

Paradoxically, most of the local semi-wild medicinal plants—46%—are extracted from village farms. These are plants that a farmer or his neighbor recognizes for one or more uses, and they are deliberately overlooked during weeding in order to ensure their availability for existing or anticipated needs (Etkin and Ross, 1994).

These simple statements conceal a complex situation. Apparently the Hausa farm is not just a plot of millet, or of groundnut intercropped with guinea corn. It is a space that combines intentionally cultivated plants with adventitious guests. This is a shifting assemblage whose resident population changes each growing season depending on who farms the land and how, and whether the non-crop colonizers are deemed worth managing for the short duration of the season. Whereas

individual farmers both appreciate and encourage this botanical heterogeneity, it has not been recognized by agents of conservation and development who are physically and culturally detached from the local scene, or by agricultural extension workers who are trained to see ‘crop’ and ‘weed’ and nothing in between.

Like the earlier examples cited, then, Hausa sustain some measure of biodiversity through their varied management of cultivated and other lands.

4.2. *A Hausa ‘conservation ethic’?*

But Hausa have no articulated ethos, no grand scheme, about the relationship of humans to other species in their environment (e.g. as stewards, servants, spiritual links, or defenders of the consecrated). Nor is there a practiced discourse about conservation per se. Still, certain customs evoke a general attitude of providence. Plant species represented by only a few individuals are accorded special status and are used sparingly, and not at all if an alternative is available. Although a few medications specify plants growing at a particular locus, the great majority can be collected widely. (Indeed, although several prominent trees are culturally marked in ways that encourage collection of various of their parts, they have not been damaged by over-collection from those individuals.) The fundamental logic against overgrazing applies to plants of all types, regardless of abundance. And Hausa share the phytochemist’s reasoning that whereas fresh plant material may be preferred in some cases, dry will work just as well most of the time. Among this devoutly Moslem population, these practicalities are overlaid by Koranic injunctions against the intentional waste of resources generally, so that future generations will benefit. Collectively, these attitudes promote conservation, but this is more a utilitarian efficiency than a credo, and certainly not unique to Hausa.

More significant for the preservation of biodiversity in Hausaland is the continued use of a large number of plants in a variety of contexts. In earlier publications we demonstrated the extent of overlapping contexts of use. I mention it here to

underscore the pharmacologic implications of conserving biodiversity. Simply stated, the full pharmacologic potential of a plant cannot be understood unless attention is paid to all contexts in which the user is exposed to active constituents (Etkin, 1994b; Etkin and Ross, 1994). Framing this in terms of conserving biodiversity, the multiplicity of uses of a plant identify its importance to the local community, and so accord it a priority for conservation. It becomes obvious, then, that a detailed knowledge of local plant use, including conservation, is a necessary step in arresting the trend toward diminishing biodiversity. In recent years, this sentiment has been echoed by Nigerian federal and state ministries of agriculture, as well as agroforestry concerns throughout West Africa (Osemeobo, 1990; Okafor and Caldecott, 1991; Osemeobo, 1992; Norman, 1997). The emergent consensus is that rural landowners should be included in integrated, cross-sectional cooperative efforts to foster sustainable conservation of biodiversity.

4.3. *Hausa responses to conservation programs imposed from outside*

Hausa responses to external pressures for conservation have, predictably, met with mixed success. As one finds elsewhere in the developing world, resistance can be explained by project design that is not sensitive to local patterns of land use and resource exploitation in all its guises.

For example, given the keen competition for land, villagers have resisted government or commercial pressures to involve their land in conservation measures that jeopardize land use for subsistence. The very nature of small-holder land ownership¹ makes certain aspects of externally imposed in situ conservation unwieldy: discontinuous ownership precludes the development and maintenance of large stands; plant assemblages

¹ Technically, since legislation of the Land Use Act in 1978, the Nigerian government owns all land, and individual ownership has been replaced by occupancy rights. In practice, however, the Land Use Act is enforced in (some) urban areas while customary land tenure systems preside in the rural areas (Famoriyo, 1987; Osemeobo, 1992).

may not be uniform from one farm to the next, even when adjacent plots are owned by the same person; and because the local land-tenure system is sufficiently fluid so that ownership is not rigidly bound to land use, this creates a good likelihood of discontinuities in planting strategy from year to year.² Also, individual plants may be owned, and not necessarily by the same person who owns the land on which they grow; this holds especially for trees valued for fruit, livestock fodder, and firewood. (It applies less to medicinal plants which, by common courtesy, one can collect even on land one does not own.) Stienbarger (1990) has reviewed how land-use strategies are informed by land and tree tenure systems in the context of the special case of trial introduction of 'alley farming', an agroforestry technology that involves intercropping fast-growing leguminous shrubs and trees with tuber and cereal crops. (See Fortmann (1988) for a review of the hierarchical structure of rights to tree use, and its relationship to land tenure.) Whereas the Hausa case of land and tree tenure is rather straightforward, this is more complex in other societies where tenure covaries as well with gender of owner, type of tree (or other plant), relative scarcity of the species, commercial value, and growing location on the plot (Fortmann, 1988; Stienbarger, 1990; Kreider Henderson, 1995). It is clear, then, that conservation efforts must take into account local land and tree tenure systems. Tenure ambiguities frustrate conservation strategies for tree-planting on private land, because individuals are not sure that the tree so planted belongs to them in the same way that their other on-farm trees do. The introduction of exotic species is even more ambiguous since the utility of such trees exists (at least for the short term) outside of local paradigms.

At present, Hausa village resistance to agricultural development also sustains species diversity. The greatest threat takes the form of schemes that

promote mechanized and chemical-supported cultivation of a small number of plants. As elsewhere, such efforts have largely focused on food plants, including cash crops. The explicit goal is to diminish the number of varieties, which has as one effect botanical and cultural homogenization of the landscape. This fosters a marked reduction in the diversity of 'non-staple' and 'non-crop' species, which would eliminate many of the semi-wild plants used in medicine, cosmetics, and the like. Those same programs advocate the consolidation of land holdings, which would effectively do away with the farm borders from which a large number of 'semi-wild' plants are exploited. Large-holder land management and monoculture are inconsistent with Hausa land management based in polyculture, mixed habitats, and the fostering of non-crop plants on farms.

5. Conclusion

The concluding discussion distinguishes the style and success of two programs for introducing trees into Nigeria, in order to draw attention to the cogency of local models of plant use for conservation efforts.

In the late 1950s Nigerian government afforestation and reforestation programs saw renewed efforts in the savanna regions, including Hausaland and the study village. Species and provenance trials focused on the introduction of a few species to address local shortages of wood: *Azadirachta indica* A. Juss., Meliaceae (*darbejiya*, neem; from Burma, via India); *Dalbergia sissoo* Roxb., Fabaceae (*dalbajiya*, *sisso*, *shisham*; India); *Eucalyptus* spp., including the hybrid *E. saligna* Smith, Myrtaceae (*sandal*; eucalyptus; Australia); *Gmelina arborea* Roxb., Verbenaceae (no Hausa name; grey teak; India); *Tectona grandis* L.f., Verbenaceae (no Hausa name; teak; India). These and, later, other species were developed in fuel and timber plantations (Ojo and Iyamabo, 1977). Three of these species were planted in the study village: *Azadirachta indica*, *Dalbergia sissoo*, and *Eucalyptus saligna*.

For several decades a small plantation of *Dalbergia sissoo* has been tolerated on the southwest

² The arrangements by which one can cultivate land that one does not own include, for example, simple 'free' seasonal loan (*kyauta*); transference of usufruct as collateral for a cash loan, with usufruct restored after the land owner repays the loan to the user (*jingina*), and land rights held 'in trust' (*riko*) (Ross, 1987).

periphery of the village because the government invested in a long-term lease for the land involved. But, despite years of its presence, there is almost no local knowledge of the attributes or uses of this tree. On the other hand, the other two species were introduced as individual trees into the context of village public, residential, and to a lesser extent farming lands. This afforded the opportunity for villagers to interact with the new species in much the same empirical manner that they engage naturally- and self-introduced elements of their environment. *Eucalyptus saligna* wood is valued for construction, and various parts of the plant are used medicinally. Primarily it is confected as one of several varieties of incense; this plays an important role in the mediation of sorcery, spirits, and witchcraft—which are a part of every-day (largely preventive) medicine in Hurumi.

The more remarkable example is that of *Azadirachta indica*, which was first introduced into the Nigerian savanna from India in 1928 (Ogigirigi and Adekiya, 1977; introduced in 1936 according to Adeyoju, 1975). Nearly 1500 plantation hectares had been planted by 1964 (Ogigirigi and Adekiya, 1977), along with many individual trees for ornamental value and shade. By this time, individual trees had been introduced throughout the study village as well—first by forestry cadres, later by villagers themselves who had to meet the challenges outlined earlier for the protection of saplings in this difficult environment. The widespread knowledge and popularity of this species was readily apparent during our first extensive field study in this village in 1975. It remains a very important medicine today, the fact of which is reflected in the results of numerous laboratory studies: Hausa use of *Azadirachta indica* is consistent with the antimicrobial, antimalarial, and anti-inflammatory activities that ethnopharmacologists have recorded for these species (e.g. Abatan and Makinde, 1986; Singh et al., 1987; Bray et al., 1990; van der Nat et al., 1991; Singh et al., 1996).

Thus, even without an explicit conservation ethos, Hausa preserve diversity through their continued use of a wide variety of local plants in overlapping contexts—principally medicine, diet,

cosmetics, construction/manufacture, and hygiene. It remains to be seen whether these local conservation efforts will be adequate to the task over the long term, as well as the extent to which these observations can be generalized to other localities within and beyond Hausaland. This discussion contributes primarily to advancing theory in ethnopharmacology, because what can be generalized beyond the Hausa example, is to emphasize that careful study of local patterns of plant use (as revealed through rigorous ethnography) needs to be factored into the calculus of conservation biology.

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Perspectives in ethnopharmacology: forging a closer link between bioscience and traditional empirical knowledge[☆]

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Abstract

To what extent do ethnopharmacologists from diverse disciplines share a vision of what ethnopharmacology is and what it might become? This question was explored several years ago through content analysis of the *Journal of Ethnopharmacology* (JEP), the official journal of the International Society for Ethnopharmacology (ISE). The analysis revealed that although the published articles represent the breadth of natural and social sciences, most studies are themselves not synthetic or interdisciplinary. For the present study, analysis was extended through the most recently published issues of the JEP and compared, for the same time period, to the subject matter of another natural products journal, *Pharmaceutical Biology*. Whereas research published in the JEP better represents the interdisciplinary objectives of that journal, the difference is not striking. By way of illustration, several studies are reviewed that represent the unique, synthetic perspective that is highlighted in the mission statements of both the JEP and the ISE. The conclusion underscores the lack of clarity in research objectives and suggests that ethnopharmacologists of all backgrounds can enhance their work by projecting pharmacologic data against a backdrop of medical ethnography and by enriching cultural interpretations of medical actions by exploring the physiologic potential of plants. © 2001 Elsevier Science Ireland Ltd. All rights reserved.

Keywords: Interdisciplinary studies; Ethnopharmacology; Methods; Application

1. Introduction

The year 2000 International Congress on Ethnopharmacology provided a forum for reflection on what intellectually constitutes the domain of ethnopharmacology, what the representative vehicles are for publishing findings and what the literature suggests about research objectives. The Congress theme — Challenges for the New Millennium — suggested an opportunity to improve the substance of our research and to promote the application of our findings. Identifying challenges necessarily invites us to reflect on what we have accomplished up to this point. Most researchers agree that significant advances have been made in the technical domain — including the characterization of plant

constituents and activities and a better understanding of the interactions among elements of complex botanical preparations, as well as between plants and pharmaceuticals. In all likelihood, technical progress will characterize the next decades as well. On another positive note, our ethnographic field skills remain solid: drawing largely on anthropology, we have at hand already-tested methodologies to reveal the cultural construction of health and healing in diverse cultures. But these skills have been underused, as most researchers spend little or no time with the local people and ecologies from which test materials (plants) are drawn.

What has not kept pace are developments in the theoretical domain, and slower still is progress in the application of our research findings, both to advance bioscience and to make our work meaningful for local populations. These are important deficits, as concept and context are what position ethnopharmacology research, both intellectually and in practice. The relative lack of progress in interdisciplinary and applied domains derives in part from the fact that ethnopharma-

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Table 1
Comparative content analysis of the *Journal of Ethnopharmacology* (JEP) and *Pharmaceutical Biology* (PB)

Thematic category	JEP 1979–1996 N = 1276 (%)	JEP 1996–2000 N = 634 (%)	PB 1996–2000 N = 279 (%)
Ethnography alone	15	4	1
Pharmacology alone	54	47	71
Primarily pharmacology	16	38	17
Interdisciplinary	6	4	4
Ecology, taxonomy	<1	<1	0
Safety, regulation, CAM	5	6	4
Miscellany	3	1	2

cologists represent diverse intellectual traditions — most prominently pharmacology, anthropology and botany. In addition, some are connected to commercial enterprises, including the pharmaceutical industry and the rapidly expanding market for ‘herbals’ and medicinal foods. Will it be possible in the future to use those combined voices to forge a more interdisciplinary field of inquiry, i.e. how realistic is the vision that calls for an ethnopharmacology that yields collaboration among different researchers as well as the application of that knowledge to practical ends for both the scientific and indigenous communities?

2. Methods

2.1. Content analysis of the *Journal of Ethnopharmacology* and *Pharmaceutical Biology*

Content analysis methods have a long history in social science research. In the abstract, these techniques reduce the tangible ‘artifacts’ of human behavior to a unit-by-variable matrix that is analyzed quantitatively in order to discern patterns. These artifacts are highly varied and include medical interviews, political rhetoric and texts, such as research journals (or newspaper editorials, song lyrics, history books). The content analysis reported here is framed by an anthropological perspective that examines text as a ‘window into the human experience’ (Bernard and Ryan, 1998), the fenestration in this case casting light on perceptions and objectives in ethnopharmacology research. The specific objective of this content analysis was to discern the extent to which ethnopharmacologists from diverse disciplines share a vision of what ethnopharmacology is. The issue of shared perspectives in ethnopharmacology was explored preliminarily several years ago through content analysis of the *Journal of Ethnopharmacology* (JEP), which is widely regarded to be a key gauge of topical concern in ethnopharmacology. The JEP is unique among journals that publish research on natural products because its mission statement and scope highlight a commitment to interdisciplinary research and a breadth of interest in both phytochemical characteriza-

tion and the cultural context of indigenous drugs. It serves as the official journal of the International Society for Ethnopharmacology, a professional association whose membership coheres around interdisciplinary research on the physiologic actions of plant, animal and other substances used in indigenous medicines of past and present cultures.

More than 1200 JEP articles were reviewed, from volume 1 in 1979 through volume 50 in 1996, to judge how closely particular studies represent the intellectual fusion implied by the compound term ethno-pharmacology (Etkin and Ross, 1997). That retrospection suggested that whereas the published articles represent the breadth of natural and social sciences, most studies are themselves not synthetic or interdisciplinary. Very few combined pharmacologic data with sufficient ethnographic depth to make substantive statements about how specific plants influence the health of a particular population.

These findings do not reflect the policy of either former or current JEP editors and Editorial Boards. Instead, the topical distribution of articles is a complex artifact of the boundedness of disciplinary training and funding, as well as who actually submits manuscripts to the JEP. In fact, the editors and Board responded to the study’s findings by reaffirming their commitment to an interdisciplinary ethnopharmacology that resonates the complex circumstances of diverse medical cultures who interpret and physically manage biodynamic materials.

Now, 4 years later, the intellectual waters have been retested by extending JEP content analysis and comparing that to another natural products journal, *Pharmaceutical Biology*. A cursory review suggested that the same thematic categories are relevant. The journals’ contents were then systematically examined and each article was assigned to one of seven mutually exclusive categories, based on a judgement of best fit (Table 1)¹.

¹ Only 8% of all articles fall into the thematic categories ‘ecology and taxonomy’, ‘safety and regulation’ and ‘miscellany’ (e.g. laboratory methods) and are not part of this discussion.

3. Results and discussion

3.1. Topical themes

The category ‘ethnography alone’ includes medical ethnographies and historical treatments based in literature review. These articles address the cultural, not the pharmacodynamic, characteristics of plants. This is apparent, for example, in an article that outlines the cultural context of Amazonian rituals, with an appended list of medicinal plants and their preparations. Other authors listed medicinal plants and uses in Dadeldhura, Nepal and for the Tacana of Bolivia. Similarly, other authors itemized medicinal plants for Badajoz Province of Spain and selectively compared the use of several species with their medicinal applications in other parts of the Mediterranean. These works represent folklore and ethnography, but are not *ethno-pharmacology*. Their contribution to the larger enterprise could be even greater if the meaning of medicinal plants, their transactions and social negotiation was taken into account, as well their biodynamic attributes.

‘Pharmacology alone’ is the predominant thematic category and includes pharmacologic and phytochemical studies that characterize plant constituents and activities without reference to the pharmacopoeia and culture of the people who use the plants. For example, one research group reports testing extracts of *Barleria prionitis* for antifertility effects, but notes in the opening paragraph that mediating fertility is not among the various applications of the plant in Indian indigenous medicine (where it is used for fever, cataract and boils). Similarly, other researchers report anti-cancer (apoptosis-inducing) action for tanshinone IIA isolated from *Salvia miltiorhiza*, having stated that the plant is used in ‘traditional oriental medicine’ (but which ‘oriental’ tradition?) for angina pectoris. These studies are acontextual pharmacology, rather than *ethno-pharmacology* that takes into account how people identify, prepare and administer plants, and how they judge efficacy. These cultural aspects of medicine are as important as, and overlap, the biological actions of the plants.

Many studies are defined by the ‘primarily pharmacology’ theme, which still centers on phytochemistry but includes some ethnographic data as well. Ascription of articles to this category is generous because in most, the ethnographic information is thin and is not well integrated with laboratory findings. For some of these studies, ethnographic aspects are drawn from old published sources, which are not salient for the contemporary culture that bears the same name. In many cases, the ethnographic data are used selectively as researchers focus on a medicinal application that corresponds to their current interests and existing laboratory protocols. Lately, for example, many laboratories are interested in anti-inflammatory, antioxidant and antinociceptive ac-

tions. Although a wide range of disorders would benefit from such actions, it is not clear what implications these findings have for the cultural group identified in the study.

Examples of the ‘primarily pharmacology’ theme include studies that tested for angiotensin-converting enzyme (hypotensive) or for antiplasmodial activity. In both cases, the applications tested are only remotely related to those for which indigenous populations use the plants. Further, there is insufficient ethnographic content to ensure that the dilution and extraction mode in which the plants are laboratory-tested corresponds to how indigenous healers prepare and administer those plants in preventive and therapeutic medicine. In these cases, readers cannot judge whether traditional therapeutic objectives overlap biomedical ones — for example, these plants may not be intended to reduce blood pressure and parasite load, but instead to cause sweating to chase the disease agents from the body. However, it is encouraging that more of the studies published in the JEP make reference to some ethnographic reality. In this ‘primarily pharmacology’ category, we begin to see the potential complementarity of aspects of ethnography and pharmacology.

In the ‘interdisciplinary’ category, ethnopharmacology is framed by a biocultural perspective that lies at the heart of a truly integrated, not just multidisciplinary, ethnopharmacology. ‘Interdisciplinary’ works differ from the ‘primarily pharmacology’ studies by including ethnographic data of sufficient depth to generate and test hypotheses and to make substantive statements about medicinal plant use in actual human populations. Such papers include systematic information about disease etiology, plant preparation, mode of administration, therapeutic objectives and other germane details that equip the researcher to understand how local cultures understand and mediate the biodynamic potential of medicines and, to a large extent, anticipate the physiologic outcomes of plant use. Here, researchers regard indigenous peoples to be, similar to Western scientists, competent interpreters of their physical environments. They, like their counterparts who mediate the culture of Western science, embellish the cultural meaning of botanicals by marking and managing biodynamic substances through such attributes, such as action, taste, efficacy and odor.

One interdisciplinary study presented the cultural presuppositions of Zulu medicine, discussed the social organization of healing, problematized the study to a subsample of the pharmacopoeia that is used to treat headache and specific inflammations, detailed the preparation of medicines and tested extracts for prostaglandin-synthesis inhibition (Jäger et al., 1996). Another interdisciplinary study used extensive ethnobotanical and ethnomedical data to examine Zapotec medicinal plants, especially for dermatologic and gas-

Table 2

Comparative content analysis of the *Journal of Ethnopharmacology* (JEP) and *Pharmaceutical Biology* (PB) — research objectives

Objectives	JEP 1979–1996 N = 1276 (%)	JEP 1996–2000 N = 634 (%)	PB 1996–2000 N = 279 (%)
Bioprospecting	28	12	42
Biodiversity	3	<1	1
Indigenous use	NA	3	7
Ethics	NA	0	0

trointestinal disorders (Frei et al., 1998). Further, these researchers showed how this population distinguishes medicinal from nonmedicinal species (including foods) by smell and taste, noting especially astringent, aromatic and/or sweet characteristics. These culturally defined clues not only encode information about which symptoms a particular plant treats best, but also juxtapose cultural salience to bioactivity — e.g. constituents (polyphenols) present in the plants used for digestive complaints are responsible for both astringent taste and efficacy in the treatment of intestinal disorders (Brett and Heinrich, 1998; Ankli et al., 1999).

The point is that interdisciplinary studies effectively combine ethnography and pharmacology to formulate meaningful conclusions regarding how local healers effect cure, how chemosensory properties of plants influence their indigenous medicinal uses and how phytochemical knowledge might be applied in the formulation of new pharmaceuticals that could serve local needs, as well as those of Western science. They reveal the complementarity of ethnographic and pharmacologic data, to offer insights into how healing is constructed and efficacy evaluated in particular human cultural contexts.

3.2. Comparison of the JEP with Pharmaceutical Biology

A systematic content analysis was engaged for the journal *Pharmaceutical Biology* (PB), for the same time period. This journal was formerly (until 1996) titled *International Journal of Pharmacognosy* and still is expressly devoted to pharmacognosy — i.e. inquiry on the botanical sources and chemico–physical characterization of crude drugs. Although the scope of *Pharmaceutical Biology* resonates more strongly the laboratory aspects of ethnopharmacology, it does publish papers that overlap the range of thematic foci covered in the JEP and thus, serves as a basis for comparison.

Data comparing the contents of the JEP and PB are summarized in Table 1. Compared to the earlier analysis, the number of ‘ethnography alone’ studies in the JEP has diminished appreciably, while the number of ‘pharmacology alone’ studies has decreased fractionally, from 54 to 47%. This means that most of the JEP articles still represent an uninflected pharmacology

rather than ethno-pharmacology. Predictably, given PB’s different mission and scope, the percent of ‘pharmacology alone’ articles published in that journal is significantly higher, 71%. The number of JEP papers that embellish pharmacology with at least a little ethnography has more than doubled, increasing from 16 to 38%, while the comparable figure for PB is half of that percentage.

Overall, then, the JEP publishes fewer ‘pharmacology alone’ studies and more articles that include some ethnography. While we can be encouraged that more attention is paid to the cultural contexts of plant use, the number of truly interdisciplinary papers remains very low. Only a few synthetic studies appear in both phases of JEP analysis; and for the latter phase, the percentage is the same as for PB, a journal in which one does not expect to encounter interdisciplinary perspectives.

3.3. Research objectives

It seems clear, then, that many authors still position their research in a Western pharmaceutical frame without considering the implications for populations from whom plant knowledge originates and who continue to use those plants. This observation led to the next stage of research, the extension of content analysis beyond topical foci, to identify research objectives. Authors specified one or more of these aims:

- Bioprospecting, i.e. advancing pharmaceutical science by seeking leads for new drugs that will be added to the biomedical pharmacopoeia
- conservation and preservation of biodiversity
- promoting the indigenous use of local botanicals, including in combination with pharmaceuticals and other biomedical technology
- ethics and intellectual property rights

The potential was high that any given article would have more than one objective although, curiously, most stated none at all (Table 2). Judging from these percentages, it appears that ethnopharmacology has not been appreciably influenced by the very public and political attention to biodiversity, ethics and intellectual property rights. Because the debate on these issues has permeated the literature of anthropology, economic botany and other disciplines for the last decade or so

(e.g. Lempert, 1997; Myer, 1998; Nair and Jayakumar, 1999; Porembski and Barthlott, 2000), it seems odd that it would not have reached ethnopharmacologists — who overlap those other sciences and who are not immune from moral conscience.

In view of its mission and scope, it is not surprising that bioprospecting is the research objective of 42% of articles published in *Pharmaceutical Biology*. By contrast, in the earlier JEP content analysis, 28% of authors specified pharmaceutical leads as an objective and in recent years, 12%. A possible, and obvious, interpretation of this downward trend is that research objectives have shifted. However, this analysis does not support that conclusion.

For the early content analysis it was troubling, distasteful even, that bioprospecting would predominate among research objectives. After all, from an anthropological perspective, it is more important to know what local people will gain, or at least how their circumstances will be better understood, from the study of their medicines. On some level, this is less troubling now. Drug discovery and other entrepreneurial ventures are, after all, legitimate — even those that do not qualify as ethnopharmacology. What is more disturbing now is that most researchers appear to have no objective at all, at least most authors do not state what the purpose of their research is. Perhaps they assume that all ethnopharmacologists are part of the same enterprise and that statements of purpose are therefore unnecessary. Still, one is left with the sense of discrete bits of research emerging from various laboratories with nowhere to go and no one to pull them together. By all appearances, no one seems to reflect much on what the larger picture might be.

3.4. *Ethnopharmacology for whom?*

But if these researchers are indeed interested in drug development, who are their findings for? With whom will they collaborate? Pharmaceutical companies, after a spate of energy and significant expenditure in the early 1990s, have since been losing interest in natural remedies (e.g. Williams, 1997). In part, this reflects that drug development requires substantial capital and a long approval process, some estimate 10–20 years of research; and only a very small percentage of candidates reach the market as effective drugs (Cragg et al., 1995).

The pharmaceutical industry's declining interest in natural products also has something to do with the 1992 Convention on Biological Diversity (Convention, 1992) which positions indigenous peoples as the rightful owners of indigenous medicinal plant knowledge and its applications. Despite the sincere efforts of the Convention and other professional associations to establish

codes of ethics², the extension to indigenous populations of intellectual property rights is complex and difficult to implement. It is politically nuanced and multi-cultural and involves actors who represent diverse constituencies that are highly asymmetrical with respect to access to authority and resources. When intellectual property rights are further extended by profit-sharing and contractual privileges, this makes prohibitively expensive what was already a very costly venture. Liability, cost-containment and profit motive have had an impact on drug development and many pharmaceutical companies now see their future in genetic engineering, rather than botanical medicines (Gwadz, 1994; Melton, 1999).

If the pharmaceutical companies will not use the findings of natural products researchers, who will? One could speculate that some of the former interest in natural products would be transposed to the development of botanical complementary and alternative medicines (CAM), but these have proven to be marketable and profitable without much, or even any, scientific validation. In the US, the 1994 Drug Supplements Health and Education Act (DSHEA, 1994) has had a profound effect on the regulation and marketing of botanicals, which can be sold as 'dietary supplements' that are not subject to the strict regulation that applies to FDA supervision of drugs. Market expansion is well ahead of substantiation and has driven these unregulated and non-standardized products into readily accessible markets, such as conventional drug, grocery and 'health foods' stores, internet sites and multi-level and other marketing schemes (e.g. Ernst, 2000). Given the profit margin and rapidity with which these products can be put on the market, there is no apparent incentive for CAM marketers to collaborate with legitimate phytochemists to characterize and standardize their products.

3.5. *Applying research results*

At the same time that the pharmaceutical companies' interest in natural products wanes, health care providers in the developing world are calling for practical implementation of research results. How can we reconcile that research conducted during the last two decades has yielded an enormous amount of information on plant constituents and activities with virtually no practical application? As disconnected primary findings continue to accumulate, our knowledge base expands. Ten more, 70 more lists of 'they use this for that' (from ethnographers) and 'this contains that' (from pharmacologists) does provide a foundation, but

² For example, the International Society for Ethnobiology, American Anthropological Association, Society for Economic Botany (ISE, 2000).

the challenge now is to direct more attention to using that as a basis from which to formulate analysis and application.

Is it true, then, as the popular media suggest, that the 'tropical rain forest is a pharmaceutical failure' (e.g. O'Connor, 2000)? Decidedly not, and this question raises other issues in the application of research findings. Who will be the primary recipient of whatever benefit natural products research offers — the West, where much of the pharmacologic research is conducted, or peoples of the developing world who continue to bear the greater disease burden at the same time that they are the source of many of the botanicals being tested? Today, the interest that many pharmaceutical companies have in primarily developing-world diseases has more to do with implications for Western travelers than with indigenous populations who cannot afford expensive prophylaxis and therapy.

Ethnopharmacologists could accept a challenge to turn this around. It would be provident at this juncture to address how the results of sophisticated medical ethnography and rigorous bioassays can be meaningfully integrated, translated and applied to the traditional populations who use those plants. At minimum, once a catalogue of promising leads has been identified, those botanicals should be further studied, at least through preliminary clinical observation. Especially in resource-poor settings in the developing world, the use and sustainable cultivation of those plants should be encouraged.

4. Conclusion

I think that every few years it merits taking the pulse of our discipline, to track us intellectually and gauge our future. I encourage a recommitment to an integrated ethnopharmacology, both to advance the field and to ensure that the JEP does not lose its unique focus. Specifically, I recommend that ethnopharmacologists of all backgrounds project pharmacologic data against a backdrop of medical ethnography (e.g. by addressing therapeutic objectives, specific contexts of use, preparation, etc.). We should also enrich cultural interpretations of medical actions by exploring the physiologic potential of plants — consulting literature outside their own professional disciplines and collaborating where necessary.

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Should we set a place for diet in ethnopharmacology?

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Ethnopharmacologic inquiry is most evincibly pursued by addressing “medicinals” across the diverse contexts through which populations gain exposure to the material of their pharmacopoeia. Attention to multiple categories of use advances our comprehension of indigenous health care by providing a framework for laboratory investigations that explore the bioactive potential of the materia medica to influence the occurrence and expression of disease, and that determine how those physiologic outcomes may be further mediated by the context-specific vicissitudes of preparation, combination and consumption. Consideration of the dietary contexts of local “medicines” is central to this wider perspective.

Introduction

The purpose of this presentation is to draw the attention of ethnopharmacologists to the dietary dimension of plant utilization. The conventional approach in ethnopharmacology is to focus on the medicinal properties of plants without adequately exploring other categories of use. As a result, we are unduly circumscribed in our understanding of the extra-nutritive aspects of food phytochemistry. The contacts that people have with plants are as apt to occur outside of therapeutic contexts as within. Among alternative contexts, diet looms the largest in terms of both plant diversity and quantity. We believe that ethnopharmacologists, when evaluating the phytochemical effects of indigenous medicines, should also address questions regarding the associated effects of dietaries. The importance of recognizing the relatedness of use categories in ethnopharmacologic studies is the central theme of this paper. We draw inspiration from the Hausa term for medicine, *magani*, a concept so inclusive that it signifies “plants administered to cure fever”

as well as “foods used to remedy hunger.” Our intention is to suggest a multi-contextual framework for assessing the physiologic import of plant utilization, to help to move the field beyond the contriving of simple, abstracted catalogues of constituents and activities to the assessment of interdependent uses of plants by real populations in specific cultural contexts.

Using examples drawn from the literature and from our research among Hausa in Nigeria, we review various pharmacologic approaches to the investigation of food plants. We then discuss how studies of diet and medicine can be mutually complementary, and we conclude by proposing a methodologic framework for synthetic studies that accommodate the varied and interconnected uses of plants.

Food and medicine

General effects of food plants on human health have been reported in the scientific literature. Researchers of Chinese and other Asian medicines especially stress the importance of foods in illness prevention and therapy. They focus primarily on food ideologies through abstract referents such as “therapeutic” and “healthy” foods, or via paradigms of binary opposition such as hot-cold

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and sweet-salty, as these symbols guide plant use (e.g., Laderman, 1981; Wilson, 1981; Koo, 1984; Ho, 1985). Stone (1983) presents an interesting discussion of ritual feeding and other food transactions that mediate illness in Nepal, although he mentions only one plant by name. But, when food plants are included in detailed pharmacologic studies, there is a tendency to concentrate on the more exotic items among them, such as spices.

Alternatively referred to as seasoning, condiment, pot herb, flavoring or relish, the "spice" food category combines plants predominantly as culinary flavors. Some, like the capsicums in South America and West Africa, encode powerful metaphors for regional cuisines. Because spices have been so closely linked to medicine in western society, it is no accident that they predominate among pharmacologic investigations of food plants. Tropical spices especially penetrated European cuisines as appropriations of the exotica during colonial expansion. We do not know whether they were first used in their places of origin for taste, or for other qualities. For example, ginger and garlic are used worldwide by diverse peoples who describe their taste with high regard; but perhaps they were first appreciated for food preserving (antioxidant) and antimicrobial qualities, with taste acquired only secondarily. Europeans learned those same contexts of use and included many of the common spices in their national formularies.

The classification of spices as medicine has led us to investigate their pharmacologic qualities. Standard texts and journals record the antibacterial principles in ginger (*Zingiber officinale* Rosc.) and chile pepper (*Capsicum annum* L., *C. frutescens* L.), estrogenic and hypotensive activity in anise (*Pimpinella anisum* L.) and fennel (*Foeniculum vulgare* Mill.), anthelmintic action in epazote/wormwood (*Chenopodium ambrosioides* L.), and anti-inflammatory and antimicrobial effects in onion (*Allium cepa* L.), garlic (*Allium sativum* L.), basil (*Ocimum basilicum* L.), fennel, epazote and ginger. Turmeric (*Curcuma longa* L.), licorice (*Glycyrrhiza glabra* L.), cinnamon (*Cinnamomum verum* J. Presl) and ginger promote gastric mucosal integrity. Extracts of mace and nutmeg (*Myristica fragrans* Houtt.), clove

(*Syzygium aromaticum* Merr & Perry), turmeric and garlic (*Allium sativum* L.) diminish platelet aggregation. Ginger, cardamom (*Elettaria cardamomum* L.), clove and peppermint (*Mentha* sp.) have cholagogue action (Mukerji et al., 1961; Albert-Puleo, 1980; Kiuchi et al., 1983; Phonphok, 1983; Rasheed et al., 1984; Duke, 1985; Kosuge et al., 1985; Yamahara et al., 1985, 1988; Mohammad and Woodward, 1986; Trotter and Logan, 1986; Mascolo et al., 1987, 1989; Panossian, 1987; Abdul-Ghani and Amin, 1988; Ghannoum, 1988; Akhtar and Munir, 1989; Rafatullah et al., 1990). The list grows longer — but not productively so. Since many of the laboratory studies do not refer to context of use, we lack essential information about the incidence and quantity of consumption needed to assess the physiologic consequences of plant use. For example, researchers fail to make the point that although spices are used in small quantities to flavor food, the frequency of their consumption and overlapping uses in medicine and food may ensure sufficient exposure to effect both preventive and therapeutic action on illness.

It is not difficult to understand the paucity of studies on medicinal properties of staple foods. Domestication has for many plants entailed a substantial reduction in the kinds of secondary metabolites that repel herbivores and attract phytochemists. Consequently, domesticates have been considered too prosaic for pharmacologic study. An exception has been investigation of food detoxification. Because genetic manipulations to remove allelochemicals enhance risk of insect and disease damage, human societies have also designed post-maturation means to remove undesirable phytochemicals. These include heating, pH adjustment, adsorption (including geophagy), fermentation, sun exposure, dessication, mechanical manipulation and solution. Some of those actions are effected by other plants. For example, tartaric acid in *Tamarindus indica* L. pulp detoxifies species of Araceae by solubilizing calcium oxalate crystals, and it neutralizes rotenoids and other toxic flavonoids in *Neorautanenia mitis* (A. Rich) Verde. (Johns and Kubo, 1988). Detoxification processing of staple foods has received most attention — especially for cassava (*Manihot esculenta* Crantz.), potato (*Solanum tuberosum* L.) and other

tubers; but it is applied as well for a wide range of plant types. Barks of pine (*Pinus silvestris* L.), birch (*Betula* sp.) and elm (*Ulmus* sp.) are roasted or boiled prior to use as bread flavoring; soaking and alkaline treatment of lichens (*Cetraria islandica* (L.) Ach.; *Cladonia* sp.) prepare them for use as gelling agents; and the aquatic rhizomes of calla (*Calla palustris* L.), bogbean (*Menyanthes trifoliata* L.) and water lilies (*Nuphar luteum* L. and *Nymphaea* sp.) are detoxified by drying and macerating (Airaksinen et al., 1986).^{*} Beyond concern for toxicity, the pharmacologic banality of domesticates has been exaggerated. We would benefit from other types of pharmacologic inquiry for staples, especially since researchers have documented important roles for such plants in non-nutritive contexts — e.g., ritual and medicine — since prehistoric times (Johns, 1986, 1989; Ortiz, 1989; Warman, 1989).

There has also been little attention in pharmacologic study paid to so-called "wild" foods, perhaps in large part because this category is poorly understood with respect to what plants it includes and the extent to which they contribute to routine cuisine. Authors casually use terms such as "wild", "supplementary" and "semi-cultivated" as referents for very different types of plants, a lexical coupling that implies a collectively peripheral role in diet and nutritional equivalence, neither of which may apply. Like the spices, so-called "greens" or "herbs" are used to de-routinize cuisine or to flavor, stretch, garnish, or otherwise culturally mark other foods, including staple grains and roots. The strategic significance of these plants has been underestimated for a great number of cuisines, in no small part because the collection of such foods is commonly the work of

women and children. Even agricultural societies include substantial quantities of foraged plants in their dietaries, and may exploit a greater variety of plants than do some hunters and gatherers (Grivetti, 1979). Often these "wild" foods are categorized as "emergency" or "famine" foods, further depreciating their role as ordinary foodstuffs during times of sufficiency. In fact, wherever these categories of food have been measured carefully, one finds that they contribute significantly more volume to diet than otherwise thought.

As it influences human health, the consumption of "wild" foods has been interpreted as an adaptive strategy for periods of seasonal and long-term catastrophic shortage of cultigens. Researchers generally concede that diversity serves dietary sufficiency to the extent that it amplifies the range of available nutrients with respect to essential amino acids, vitamins and minerals (e.g., Aaronson, 1986; de Garine and Harrison, 1988; Boom, 1989; Mortimore, 1989; Newman, 1980; Fowler and Mooney, 1990; McNeely et al., 1990). A smaller number of reports catalogue isolated nutrients for selected non-cultigens — e.g., measures of ascorbic acid, vitamin A, calcium, protein and riboflavin for "wild" plants in the dietaries of India, Malaysia, Kentucky and Ohio (Caldwell and Enoch, 1972; Begum and Pereira, 1977; Zennie and Ogzewalla 1977; Joseph and Peter, 1985), and for less routinely reported sources such as *Gracilaria coronopifolia*, *Asparagopsis taxiformis*, *Spirulina platensis* and other marine and freshwater algae (Aaronson et al., 1980; Aaronson, 1986; Abbott, 1988; Perez et al., 1990).

While narrow studies of nutrient quality are valuable, we need to be concerned as well with other physiologic sequelae of ingesting these plants. For example, considerations of nutrient content may be complicated by the fact that these substances are not simply nutritive. They also interact with disease processes in ways that are more traditionally viewed as pharmacologic, as we discuss below. Another important reason to better establish the pharmacologic character of wild plants is that they — not staples or spices — are at most risk of deletion through reduced species diversity and other biotic simplifications that have become

^{*}From an evolutionary perspective, it is interesting that these actions may have antecedents in animal and other primate behavior. Non-human primates manipulate the pharmacologic and nutritive qualities of plants. For example, in natural habitats chimpanzees use unique, non-dietary strategies to acquire the leaves of special, antibiotic-containing plants. Other primates eat certain plant parts only at time of maximum pharmacologic potency, and geophagy may neutralize plant toxins through adsorbence (Wrangham and Nishida, 1983; Rodriguez et al., 1985; Johns 1989). One need not engage the hyperbole of "chimp therapeutics" to appreciate the evolutionary implications of such observations.

the signature of agricultural "development" programs.

The relative lack of attention given to ethnopharmacologic inquiries of dietary constituents reflects a conceptual problem — an often unspecified, but implicit "either/or" categorization of plant use. This is apparent in studies which inventory medicinal or food plants without entertaining the possibility that plants are not simply one or the other. Franzblau and Cross (1986) report antimicrobial activity for 13 Chinese medicinal plants without mentioning that 9 are also elements of the diet — two as principle dietary components and 7 as "tonics," "appetizers", and the like. Similarly, Telban's (1988) inventory of 93 New Guinea medicinal plants leaves unnoted that 43 of those also appear as dietary components. While ethnopharmacologic investigation of these medicinals certainly adds to our understanding of human adaptations, we are likely to draw incomplete, even misleading, conclusions about the potential impact of plant consumption unless the dietary dimension is also explored.

Fortunately, there are some departures from this narrow course of study that illustrate the merits of at least a dualistic perspective. For example, we found that among 107 Hausa plants used as medicines for gastrointestinal (GI) disorders, fully 49% are used as food as well (Etkin and Ross, 1982). Distinctions are further blurred because outside of explicitly narrow therapeutic use, those plants are administered in conjunction with other foods to make a whole meal curative, and are used also as preventive foods and medicines. We illustrate the pharmacologic potential of these plants by noting, for example, astringent and anti-inflammatory activity in 66% of those plants (e.g., *Bauhinia reticulata* DC, *Cassia occidentalis* L., *Parkia filicoidea* Welw.); demulcent and toxin neutralizing properties in 64% (e.g., *Lannea acida* A. Rich., *Mangifera indica* L., *Zizyphus jujuba* Lam.); and bactericidal, fungicidal and amoebicidal constituents in 56% (e.g., *Tamarindus indica* L., *Solanum nodiflorum* Jacq., *Momordica balsamina* L.). Our earlier application of this model to Hausa therapeutics has been widely cited, and we note comparable findings for other disease classes in our continuing investigations.

Fleuret's studies (1979, 1986) in Kenya and Tanzania suggest not only the nutritive import of "supplementals" and foods eaten outside of designated meals, but also the potential therapeutic value of such dietary constituents. She documents that consumption of fresh fruits and leaves provides important sources of calcium, iron and protein, and averts the deficiencies of vitamins A and C that have been reported for other communities who have similar diets but consume fruit and leaves in substantially smaller quantity and variety. Prominent among the 97 species of fruit foraged and cultivated by the Taita of Kenya are *Carica papaya* L., *Landolphia kirkii* Dyer, *Physalis peruviana* L., *Psidium guajava* L., and *Annona*, *Grewia*, *Lantana* and *Musa* species. Among commonly used leafy plants are *Amaranthus* sp., *Bidens pilosa* L., *Brassica oleracea* L., *Cucurbita pepo* L., *Galinsoga parviflora* Cav., *Solanum nigrum* L. and *Sonchus oleraceus* L. Some of these are, by same or different plant part, used therapeutically as well, and many are considered especially good foods to consume during illness. Boom's (1989) list of 299 cultivated and wild plant resources exploited by the Chacobo of Bolivia includes 26 plants used as both food and medicine. Anderson and Posey (1989) record 120 plants of which 18 are used as both medicine and food by Kayapo peoples in Brazil. Because these two studies report overlap between food and/or medicine with categories of "other" and "miscellaneous," one should consider that the plant constituents might also have physiologic effects when brought directly into contact with body tissues through these other uses, as through cosmetic application, for example. However, these researchers do not remark on these other potential sources of exposure to physiologically active phytochemicals. All of these investigations contain important data but fail to include useful information about the pharmacologic potential of plants used in various contexts. This situation will not change until researchers include the extranutritive physiologic significance of food plants among their research priorities. These latter inquiries especially would benefit from closer scrutiny of the pharmacologic potential of plants used in various contexts. But that study has been constrained

because at present researchers in ethnopharmacology do not typically include the phytochemistry of foods among their priorities.

For the pharmacologist, considerations of diet and medicine should be inextricably linked. Plants as food are consumed repeatedly and regularly, resulting in sustained exposure of people to whatever pharmacologically active constituents occur therein. From the perspective of prevention, items of diet may play a more important role than do medicines, which are used predominately in a therapeutic mode once illness has been recognized. A multi-contextual approach to plant use would facilitate pharmacologic investigations of dietary constituents by focusing attention on the indigenous pharmacopocia as a means of identifying plant-disease associations — that is, to choose for more extensive nutrient study plants those that are also commonly used in therapeutic contexts. Such an approach would greatly benefit examinations of indigenous medicines by drawing into consideration the possible pharmacologic implications of plant use in other than medicinal contexts.

Food for pharmacologic thought

Increasing attention is being given in the pharmacologic literature to the contexts of medicinal plant use, including information on dose and on details of preparation such as state of freshness, duration of decoction, combination with other plants, etc. (e.g., Etkin, 1980, 1986a,b, 1988a,b, 1990; John and Onabanjo, 1990; Macfoy and Cline, 1990). This is especially gratifying for those of us who try to cover the varied circumstances of plant utilization in order to assess more fully the impact of plants on people. But we need to be even more comprehensive in our assessments, particularly regarding dietary staples, condiments and supplements.

Dose

Exposure to a plant may be significantly greater than implied by dose, which properly designates only its medicinal use. Exposure refers more broadly to all contexts of ingestion and contact. When considered together, they may add significantly to dose per unit of time. To the extent

that dose and exposure are of interest, dietary uses cannot be ignored, since that context generally entails larger volumes ingested during repeated episodes of consumption. The quantity of plant consumed as medicine is likely to increase exponentially in dietary contexts. For example, Hausa plants taken therapeutically for cough — *Hibiscus asper* Hook. f., *Corchorus tridens* L., *Cyperus rotundus* L. — are prepared using approximately 3 g dry plant material in aqueous extraction drunk three times per day. As flavorings these plants increase in amount consumed to approx. 6 g dry per day, not extracted. And as major meal entries the volume consumed increases many-fold, averaging 100 g fresh per meal, once or even twice per day.

Plant preparation

Next to dosage, mode of preparation is the variable most emphasized by researchers who are interested in more realistic assessment of indigenous therapies. Significantly, the extent of dissolution of plant tissues and temperature and solvent of preparation influence the solubility and chemical configuration of constituents. Whereas this has been studied to some extent for medicines, much less is known about pharmacologically active substances prepared as part of the diet. The processing of some plants used for food involves grating, alkaline treatment and high temperature cooking in water or milk. This not only softens and renders them otherwise more palatable, but also markedly increases the solubility of constituents which might be only marginally available from medicines prepared with coarsely cut materials infused in small volumes of water, especially when medicines are prepared quickly for immediate use. In Hausa medicine leaves of *Moringa oleifera* Lam. are infused in tepid water for consumption during gastrointestinal distress, and may provide relief through exposure to emollient mucilages and some of the antimicrobial constituents. The biotransformations that occur in cooking this common food will likely be more efficacious. Heating increases further the availability of emollient gum resins, and the culinary addition of sodium chloride salt increases the polarity of the solution, thereby enhancing

solubility of the antimicrobial constituents athonin, spirochin and benzylthiocyanate. On the other hand, antimicrobial activity in cabbage (*Brassica oleracea* L.) is diminished by heating. Routine addition of *kanwa*, an alkaline (sodium-potassium) culinary salt, increases solubility of pterygospermin, a bactericide and fungicide. The latter also is more stable in the buffered solutions of cooking than it is in the simpler aqueous medicinal preparations (Watt and Breyer-Brandwijk, 1962; Gilman et al. 1980; Sofowora, 1982; Albert-Puleo, 1983). In this regard, the pharmacologically most significant exposure that humans have to plants occurs in the context of diet, or at least diet might entail a mode of preparation very different from that suggested by medicinal inquiry alone.

Interactions among constituents

In addition to preparation and amount of exposure, combination may also influence the physiologic effects of plants. A few pharmacologists have investigated the antagonistic and synergistic interactions among phytochemicals by analyzing composite recipes rather than studying medicinal plants separately. Holmstedt and Lindgren (1967) long ago noted that *Banisteriopsis* spp. potentiate the hallucinogenic tryptamines of admixed plants such as *Psychotria* spp. Noguchi (1978) observed that the pharmacologic actions of *Berberis* (antibacterial) and *Glycyrrhiza* spp. (anti-inflammatory) are mutually antagonized by the precipitation of berberine by glycyrrhizin. Constituents of a composite medicine made of ginger and black peppers (*Zingiber officinale* Rose., *Piper nigrum* L. and *P. longum* L.) act synergistically on the oxytocins sparteine and vasicine in *Spartium junceum* L. and *Justicia adhatoda* L. (Atal et al., 1981). Similarly, in plant mixtures the oxytocic and vasopressive activities of serotonin and tyramine (e.g., in *Gossypium hirsutum* L., *Cytisus scoparius* (L.) Link and *Phoradendron serotinum* (Raf) MC Johnst.) are protected by monoamine oxidase inhibitors such as myristicin and its congeners in, for example, dill, parsnips and parsley (*Athenum graveolens* L., *Pastinaca sativa* L., *Petroselinum crispum* (Mill) Nym.); and sesamin and sesamolin in sesame seed (*Sesamum indicum* L.) have adjuvant action on the sialagogue action

of pyrethrin in Spanish chamomile (*Anacyclus pyrethrum* (L.) Lagasca) (Duke, 1985; Klocke, 1989). Laudably, these studies take us some distance toward understanding better the use of plants in particular contexts.

The same consideration should be given to interactions with and among dietary constituents. Certainly this is not novel in western contexts, where dispensing pharmacists note both adverse and beneficial interactions between pharmaceuticals and foods. For example, synergistic and potentiating interactions occur between digitalis and high-calcium foods, and among alcohol-containing foods, metronidazole and narcotic drugs. Antagonism occurs between tetracyclines and high calcium or iron-rich foods. Similarly, some antibiotics are antagonized by pectic materials such as occur in apple (*Malus* spp.), Natal plum (*Carissa grandiflora* A.DC) and *Citrus* spp. And the pharmacologic potential of therapeutic iron, several antibiotics and other cation-dependent drugs is diminished by the presence of botanical chelators such as tannates in tea (*Camellia sinensis* (L.) Kuntze) (de Alarcon et al., 1979). Instructions for still other pharmaceuticals advise the taking of food, largely to reduce nausea (e.g., ibuprofen, theophylline), and some specify total food avoidance (e.g., carafate). Clearly, these interactions are also important in nonwestern settings, where they present a greater challenge to botanists and pharmacologists who generally do not share with their indigenous respondents common assumptions about medicine and food. For instance, our studies of Hausa medicine document similar circumstances of antagonism and synergism (Etkin et al., 1990). Many Hausa plants contain substantial amounts of phytates, especially in cereals and legumes, and tannins in most ligneous species. These botanical chelators have a potential malaria-suppressive effect via sequestration of iron (Murray et al., 1982; Oppenheimer et al., 1986; Heppner et al. 1988; Graf and Eaton, 1990). This action might be potentiated by the oxidizing action of other Hausa foods and medicines (*Cassia tora* L., *C. occidentalis* L., *Guiera senegalensis* Lam., *Acacia arabica* Willd.) (Etkin, 1981). Alternatively, the antimalarial effect may be antagonized by antioxidants — for example, major

radical traps such as vitamins C and E, β -carotene and selenium, which occur in high titer in some of the same plants (tea leaf, *Camellia sinensis* (L.) Kuntze; turmeric, *Curcuma longa* L.; date palm seed, *Phoenix dactylifera* L.; *Tribulus terrestris* L.; *Amaranthus viridis* L.; *A. spinosus* L.; *Solanum nigrum* L.; *Euphorbia hirta*; *Moringa oleifera* Lam.) (Begum and Pereira, 1977; Tanizawa et al., 1984; Toda et al., 1985; Rafatullah et al., 1990). Here, too, the physiologic effects of a plant mixture are mediated by the specific constituents therein.

A methodologic framework for ethnopharmacologic study: further directions

If, as we suggest, we can only appreciate the pharmacologic impact of plants through examination of all contexts of use and all patterns of combination and preparation, are we then in the absurd position of contending that we cannot know anything until we know everything? With some justification, anthropologists have been criticized for just this posture. We want to get around that by proposing a methodologic framework that is fairly comprehensive but not ambitious to the point of being unworkable.

Studies of indigenous medicine must be population oriented, with ethnographic data pursued with the same rigor that we apply to laboratory studies. At minimum, plants should be studied across all contexts of their use in order to judge population exposure to them. More than that, we need to know the specific circumstances of preparation and consumption in each context of use. Even in pharmacologic studies informed by indigenous uses of plants, it is often not clear why certain of those plants were selected for phytochemical review and laboratory evaluation. In fact some of those plants have been pharmacologically tested against pathologic conditions different from the ones that they are used to treat in their place of origin (e.g., Yamahara et al., 1990). Because intensive field research has the potential of generating a seemingly overwhelming amount of detail about the perception and content of therapeutics, we must impose a hierarchy of priorities so that we do not engage the impossible,

and almost meaningless, task of testing all plants in a given inventory. By systematizing our efforts, we can more profitably channel investigatory attention where the payoff is greatest.

One obvious strategy is to choose for study one or more of the plants used most frequently by a given population, and/or to select plants that have enjoyed considerable currency over time in a given area or are used similarly by different populations (e.g., Friedman et al., 1986; Trotter and Logan, 1986). These frequently used plants comprise a core pharmacopoeia of botanicals used in the treatment of a range of diseases, some of which may be related through common symptoms, etiology, age or season of risk and the like. These plants are in any case identified by more than simple geographic propinquity or other features of ecology and accessibility (Moerman, 1986). One can further narrow the field of study by focusing on a single illness category, such as fertility regulation (Benie et al. 1990) or neoplasms (Duke, 1986). This approach may elicit a long list of medicinal plants. We have found that among 576 plants identified in a Hausa pharmacopoeia, about 60% constitute the core of the more familiar and routinely used species. Of those, as many as one-third (34%, $n = 114$) are used in treatments for what Hausa characterize as febrile disorders. Further, 15% (17) of that smaller group of plants appear in 53% of the 129 remedies for this disease class. It would appear that this group would be the appropriate focus for beginning investigation. From another angle, the plants that are recommended for further investigation are those that appear in a large number of recipes constituting therapies for several diseases. From our work, *tsamiya* (*Tamarindus indica* L.) would certainly be singled out for pharmacologic attention, appearing as it does prominently in 140 different medicinal recipes covering a wide range of disease classes.

Another compelling strategy is to prioritize further and to select for study plants that are also used in diet, since the potential health impact is markedly greater for plants used in diet and medicine. We applied this criterion in our laboratory investigations of antimalarial activity, for which we selected among the 126 Hausa febrifuges 82 plants that are used as well in diet, either as ma-

for meal constituents or as flavoring, garnish and the like. Extracts of 20 of those plants are active against *Plasmodium falciparum* in culture (Etkin and Eaton, unpublished results). These observations augment our earlier studies in which similarly selected Hausa antimalarial plants were investigated for oxidant generating potential (Etkin, 1979, 1981). This is also the criterion that we used for parallel studies in our laboratory in which 7 of 20 plants used in Chinese medicine and diet demonstrated antiplasmodial activity (Ming-Xin Qian, Etkin and Eaton, unpublished results).

Conclusion

We conclude by briefly mentioning three research foci drawn from our field experience that illustrate in different ways the advantages of a perspective and methodology that integrate dietary and medicinal contexts of plant utilization.

(1) Our colleagues in Nigeria confront an interesting problem in trying to comprehend the development of mefloquine resistant malaria, since that synthetic drug has been in sustained use for a relatively short duration in the Zaria and Kano areas. Researchers have begun to entertain the possibility that naturally occurring mefloquine analogues in plants in this area account for sufficient exposure to have encouraged the evolution of resistant plasmodia (Lege-Oguntoye, L., Department Head, Pharmacology and Clinical Pharmacy; Ahmadu Bello University; Zaria, Nigeria, personal communication). Exposure through indigenous medicine or food alone likely would not constitute sufficiently strong selection. Thus the combination and overlap of plant uses seems important. This immediately practical health concern turns the focus of pharmacologic research temporarily on its head. It redirects attention so that we move from synthetic drugs to their natural analogues, rather than starting, as does much of pharmacologic research, by looking for properties of indigenous medicines that might prove useful in the development of synthetic pharmaceuticals.

(2) In a second area, research on seasonal and catastrophic food scarcity recalls the merits of viewing plants across the contexts of their use. Concern with privation has invariably centered on

cultigens, in order to understand how nutrient deficits so compromise the immune system that the incidence of disease, especially infectious ones, increases. This ignores the fact that resource depletion entails shortages of other plants as well, notably medicinal and food plants that people use to prevent or treat those same illnesses. To the extent that any of these plants have pharmacologic import, the consequences need to be evaluated. It is possible that with collapse of subsistence production some disease stress is eliminated because people consume more pharmacologically active foods as they replace non-available staples; alternatively, their health may be diminished due to lack of the pharmacologically active constituents that are regularly consumed during times of sufficiency.*

(3) A third research focus that benefits from attention to multicontextual plant use concerns issues of shifting resource availability. During the first of our studies in a Hausa village, we noted that cyclical patterns of food availability and consumption resulted in high consumption during the malaria season of foods and medicinal plants that have antiplasmodial potential (Etkin, 1981; Etkin and Ross, 1982, 1983). In our study 12 years later we note a marked reduction in the consumption of those plants. This trend is not related to the incursion of biomedicines or other modification in Hausa therapeutics, and is instead a result of changes in cassava consumption in this village. As we reported earlier, the plants in question were used in conjunction with cassava, which became a dominant meal during the malaria season when it substituted for depleted grains and during which time the flavoring plants were most abundant due to rainfall. Cassava consumption has decreased markedly during the time between our studies, for several reasons, including unfavorable growing conditions and increased importation of rice. One outcome is the reduced consumption of the plants for which cassava served as the culinary vehicle. Whereas one would otherwise be hard-pressed to

*At least one recent study of drought does draw attention to depletion not only of regular food plants but also of medicinals (Mortimore, 1989).

assess the health impact of decreased cassava consumption, knowledge of the pharmacologic potential of those garnishing plants underscores the significance of that dietary shift.*

Efforts to evaluate biochemical constituents of plant materials from diverse locations have focused too frequently on "medicinal plants" at the expense of those used in other contexts—most notably diet. For those of us concerned with the health implications of plant utilization for populations from which the relevant ethnographic and botanic data are drawn, this attention is disconcerting because it impedes evaluation of pertinent community exposure. This is so because the dearth of pharmacologic research on indigenous dietary components delimits information concerning the potentially most significant vehicles of human-plant contact. Further, it may make problematic the more circumscribed investigations of local pharmacopoeias. While it is commendable that recent ethnopharmacologic studies of plant medicines attempt to strike more realistic assessments by approximating dose and preparation schedules, one is hard-pressed to appreciate that level of precision when other categories of use are entirely ignored. A more synthetic approach is called for—one which centers attention on plant exposure rather than "dose" or "portion", on "ingestibles" rather than "food" or "medicine." This forces us to consider a wider range of data and helps us achieve a more integrated understanding of the effects of plant utilization on human populations.

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Anthropological methods in ethnopharmacology

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This paper reviews anthropological methods in ethnopharmacology to advance a critical and biobehavioral perspective for the construction of primary data in the light of indigenous paradigms of health and therapeutics. The unique contributions of anthropology are the conceptual and practical tools that allow one to develop the ethnography of plant use in sufficient depth to correlate with laboratory and clinical investigations of plant constituents and activities. This serves an ethnopharmacology that links bioscientific research to traditional empirical knowledge. Specific methods discussed include: key respondents, participant observation, focus groups, structured and unstructured interviews, survey instruments and questionnaires, lexical and semantic studies, and discourse and content analysis. The accommodation of rapid ethnographic techniques for ethnopharmacologic research is described, and several problem orientations based on assessments of efficacy are offered.

Key words: anthropology; methods; ethnography; rapid assessment; efficacy

Introduction

The biobehavioral perspective in anthropology

This paper reviews anthropological methods in ethnopharmacology to advance a perspective that emphasizes the importance of culture and context in the assessment of plant medicines, and to demonstrate how specific research strategies are organized to elicit the data that inform such a perspective. A primary objective is to establish the importance of documenting the ethnography of plant use in sufficient detail to serve an ethnopharmacology that seeks to link traditional empirical knowledge with bioscientific research.

Anthropology's contributions to ethnopharmacology are distinguished less by specific methods than by a critical and biobehavioral perspective. This accords primacy to indigenous paradigms of health and therapeutics and promotes an explicitly multidisciplinary agenda to explore the intertexture of biology and culture: medicinal plants are viewed as cultural objects — 'human artifacts' or 'transacted symbols' (Dow, 1986) — and also as biodynamic elements that have infinite pharmacologic potential. Both these aspects reflect people's interpretations and manipulations of their physical and social en-

vironments. The value we attach to how qualitative data foster the comprehension of both ideational and material aspects of people's lives is characteristically anthropological, although not uniquely so (e.g., de Smet and Rivier, 1989; Weniger, 1991). More recently, anthropologists have developed the same appreciation for quantification that our colleagues in the biological sciences advance; and we regard as a necessary analytic step the transformation of at least a subset of the qualitative data for quantitative analysis. From this vantage we seek data that are meaningful to local respondents and also amenable to analysis through such extrinsic paradigms as phytochemistry, pharmacology and physiology (Etkin, 1986; Werner and Schoepfle, 1987; Browner et al., 1988).

Methodology

A few anthropologists have been content in their reflection on methods to proffer the obvious, that data collection should be 'scientific' and necessitates 'interdisciplinary methods' (Bernardi, 1980; Lipp, 1989). But this suggests that anthropology should only become more like other fields of study, and in any case eludes the real issue — that the unique contributions of anthropology to ethnopharmacology rest with the depth to which we develop the ethnography that we seek to link to laboratory investigations. Using a more

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rigorous field methodology than other disciplines typically do, we want to advance beyond disembodied inventories of plant use that lack such behavioral details as criteria for selection, mode of preparation, and therapeutic or other (e.g., nutritive) objectives. Although inventories provide a basic vocabulary, they do more to decontextualize and homogenize people's experience with botanicals than they help to explicate preventive and therapeutic strategies or to provide means for exploring plants further through pharmacologic and other biomedical paradigms. At base, then, the task is to compare the outcome expected by traditional users with the biomedically defined effects of a plant, and to assess the circumstances of concordance or discordance.

Only relatively recently have medical ethnobotany and related disciplines expressed concern for the paucity of cultural details in their accounts of plant utilization (e.g., Croom, 1983; for exceptions, see Cox et al., 1989; Johns, 1990)*. In view of that, the ethnography of non-social science accounts of plant use has typically been thin. By contrast, for anthropologists, ethnographic source data derive from *fieldwork* as a 'pragmatic exercise, informed by hypotheses, theories, and concepts; aided by methods and procedures . . . and inescapably *context-dependent*' (Young, 1993, emphasis added). We argue that there are only poor substitutes for intensive field study and reject, for example, the common lament that local residents are generically secretive (e.g., Hedberg et al., 1982), 'monopolistic' (Bhat et al., 1990), and 'unwilling to divulge' information regarding indigenous medicines; or that such information 'was probably of little interest to their kin or peers' (e.g., Darias et al., 1986: 169). We do not anticipate, as others have, only 'poor rapport and sterile communications' (Kyerematen and Ogunlana, 1987: 194) between the researcher and the study community. Anthropologists work in a positivist tradition that oversteps that naivete and cynicism and contends that, within limits, an ob-

jective portrayal of other cultures is possible; we are confident that we can communicate our interests to the satisfaction of local residents; and our experience persuades us that people are indeed interested in their culture and in its preservation. Thus, we set as high priority that our research objectives be understood locally and that residents find in their participation a value that transcends whatever immediate remuneration we offer.

Historically, one of the recognized strengths of anthropological research has been the elaborated description of relatively small, circumscribed communities. Today we recognize that even the most remote populations are not isolates and that, beyond their particular boundaries, ethnographic data can be used to demonstrate linkages between micro- and macrolevels in such a way that we understand not only the plants that particular populations use, but also how decisions regarding plant use are affected by larger regional, national and global systems. In other words, we position the use of medicinal plants within larger dynamic processes to examine how people-plant interactions are affected, for example, by communication with other populations which results in the exchange not only of plants, but also of diseases. This sets into play processes of experimentation and the creation of new therapeutic knowledge for illnesses with which a population previously had no experience. Or we explore the extent to which the evolution of market economies, or the creation of irrigation schemes and other agricultural innovations, affect the availability of medicinal plants. Similarly, we are interested to learn how increased accessibility of pharmaceuticals affects the perception and use of medicinal plants. These questions are infinitely complex, yet they can be illuminated significantly through good ethnography.

The value of ethnographic study has generally been acknowledged only for the first tier of basic research (e.g., Kyerematen and Ogunlana, 1987), that is for generating from field study and literature review information regarding the when, where and how of plant utilization. But the potential contribution of ethnographic study to later phases of investigation has been overlooked: details of culture and behavior have been considered extraneous to laboratory investigations of pharmacologic mechanisms and clinical evaluations of medicinal plants. I demonstrate in this paper how ethnographic data can, and indeed should, inform all phases of the research endeavor.

In the construction of primary data, the tools of

*One could speculate that failure to report methodology reflects a certain scorn that has been directed against anthropologists for their 'mystification of the biota' and their 'excessive attention' to cultural detail. At least anecdotally, many biological scientists regard as rather facile the in-field recording of data about plant use, compared with the laboratory analyses that follow, the 'real science'. One might interpret this to reflect as well some disregard for the populations from whom information and plants alike are being extracted and to whom botanists and others continue to refer pejoratively (perhaps unmindfully) as 'primitive', 'non-scientific' and the like.

anthropological research are applied toward clarifying the complexities of culture. None is used in isolation and, neither formulaic nor ready-made, these must always be adjusted in some manner to the local scene. In view of the high esteem in which the social and biological sciences hold procedural rigor, it is something of a paradox that methodologies (the intentioned perspectives that shape the research program) are rarely explicated in ethnomedical studies and even specific methods escape mention (among exceptions are Trotter and Logan, 1986; Encarnacion Dimayuga et al., 1987; Cox et al., 1989; Johns et al., 1990; Bhat et al., 1990; Erkin and Ross 1991a; Dagar and Dagar, 1991). Mindful of that, I offer discussion of techniques which comprise: key respondents ('informants'), participant observation, focus groups, unstructured interviews, surveys and questionnaires, lexical and semantic study of native categories, content analysis of oral traditions, and archival and other literature review (Ellen, 1984; Miles, 1984; Bernard et al., 1986; Mishler, 1986; Bernard, 1988; Peltó and Peltó, 1990). Familiar though these terms are to the anthropologist (and to other inveterate field researchers), they deserve brief definition here and specification to the objectives of ethnopharmacology.

The construction of primary data in anthropology — specific methods

Key respondents or consultants are individuals regarded as having a more extensive vocabulary about local social and cultural systems than others in the community; and they have typically been encouraged to conceptualize cultural data in the frames of reference that anthropologists employ. Whereas such an individual has long been a leading player in anthropological inquiry, field researchers today recognize the merits of samples that are at least more diverse, if not representative of the universe from which they are drawn (e.g., Tippe, 1989; Peltó and Peltó, 1990). Nonetheless, long-term, intensive collaboration with one or more key respondents is a particularly effective research strategy in ethnoscience and linguistics, both of which are central to ethnopharmacologic inquiry. And key respondents can still play important tutorial roles in the identification of relevant topics and design of survey instruments, and contribute as well in the collection and interpretation of data.

In a more abstract sense, and related to reflections on the 'key-ness' of individuals, method-

ological issues that concern anthropological studies of plant medicines include the apprehension of units of observation, distinguishing for example between 'emic' and 'etic' views — that is, between insider and outsider perspectives. While there is current debate about the serviceability of these oppositional terms (e.g., Headland et al., 1990), they have contributed to the development of theory in anthropology by heightening our sensitivity to the interpretation of data, especially to the nature of potential disparities between the viewpoint of the observer and that of the observed (Young, 1993)*. As it concerns ethnopharmacology, failure to reconcile insider/outsider differences is most apparent in the critiques by phytochemists that indigenous plant uses have no bioscientific rationale and thus are not efficacious. I raise this issue again later in this paper to discuss how the objectives of therapy differ within and between communities, making problematic the imposition of a standardized format for the assessment of efficacy.

Over the last two decades, researchers have come to recognize that, even within small and superficially undifferentiated groups, there exists considerable heterogeneity in how people perceive illness and organize treatment. Herbalists, shamans and other specialists are valuable sources of (especially esoteric) information; but they are defined more by the unique experiences of individual lives, whereas disease prevention and treatment are ongoing community activities that need to be explored among the diffuse exoteric sources of botanical knowledge. These other people who are knowledgeable about plants include food preparers, religious functionaries who use plants in sacred rites, hunters who experiment with paralytics and poisons, animal tenders, and so on. Significantly, the medical epistemologies of lay persons are often different from those of healers in the same community; symptoms may be variably configured to define illnesses, different etiologies may be ascribed to like symptoms, and so on. In this regard, attention to intracultural diversity is an important methodological aid in anthropological inquiry (Peltó and Peltó, 1990; Poggie et al., 1992). But this tends to be underappreciated by

*A good number of anthropologists (e.g., Sangren, 1988; Lett, 1991) would agree that this particular debate has reached at least one logical dead end in the position of the postmodernists (e.g., Clifford, 1988) who question whether ethnographers really can develop accurate accounts of other cultures; for them, traditional ethnography is not so much pragmatic as it is a text unto itself.

other researchers in ethnopharmacology whose duration of field study generally is shorter, and who are inclined, at least implicitly, to seek consensual reports of normative (shared/common) behaviors which are then (inappropriately) extrapolated to a community generally. There also is no significant value in the datum that 'at least one person recommends' a particular medicine. In fact, the proliferation of such accounts only dilutes the literature, making it harder still to determine which are pharmacologically efficacious medicinal plants and whether their use is sufficiently widespread to affect the health of a significant number of contemporary users. In this vein, Johns and colleagues (1990) recently criticized the anecdotal nature of ethnobotanical data born of a general disregard for reporting methodologies, and in light of which such nonrepresentative 'samples' go unnoticed.

It is significant that uneven attention to the presumed central figures — 'key' respondents and/or medical specialists — risks imposition of the bias that medical knowledge is the purview of a small (and privileged) segment of society. This ethnocentric view seeks to find parallels with what has been presumed to be the case in Europe and the US, where biomedicine prevails to enjoy considerable formalized power, but where in fact also much medical decision-making occurs (at least early on) as 'self and family treatment' within household contexts.

To remedy the bias that may be introduced through attention only to 'key' personae, a representative cross-section of local residents should be involved in all phases of the research, including the collection of voucher specimens and the selection, preparation and administration of plant medicines. Generally this elicits more information, at the same time that it assures that synonymy is recorded, and more accurately depicts the circumstances of plant identification and use throughout the community.

Participant observation entails one's involvement (cum 'immersion') in community activities with the objective to discern the details of everyday life on an experiential as well as conceptual level, the observed being comprised by both human behaviors and the environment. With this method the researcher seeks not so much a corroboration of what respondents say they do, but more importantly — through first hand experience — a substantiation that the researcher has understood what was told to her or him. Because the researcher, like any outsider, is never a part of

the community in the same way that natives are, anthropologists now recognize that their contributions to ethnography represent less 'participant observation' than they do the 'observation of participation' (Tedlock, 1991). Still, we value this above more passive, unsystematic types of interaction. For researchers in ethnopharmacology, relevant contexts for participant observation include healing ceremonies, decision-making in home and self treatments, excursions with herbalists and others who collect therapeutic plants, and situations in which plant medicines are discussed, prepared and administered. These occasions illustrate action and process; by way of repeated observations they help us to generate insights that we cannot achieve from abstracted conversations about the location and use of plants.

Focus groups are exploratory sessions organized around a specific theme that local residents are comfortable discussing in a small and informal, yet public, forum. Participants are invited from among a target group whose ideas resonate research topics, and the researcher generally serves as moderator. For ethnopharmacologic inquiry such groups can be comprised of shamans, midwives, herbalists, mothers or caretakers, and others perceived to be both knowledgeable and instrumental in plant use. This group approach creates a dynamic whereby both dissenting and concordant views provide insight into patterns of decision-making and the creation, dissemination and transformation of local knowledge regarding plants.

Throughout these and other multi-respondent sessions, it is important that local participants are not expected to achieve the consensus that would make the researcher's task tidier, but that in fact misconstrues the reality of just how dissimilar are different people's ideas and actions regarding medicinal plants. By the same token, idiosyncracies should not be allowed to obscure what patterns do occur, and which are best distilled through more systematic inquiries such as interview.

Structured and unstructured interviews are differentiated by the degree to which questions are formalized and the range and length of answers expected — unstructured, as the term suggests, referring to open-ended questions that allow respondents to elaborate to whatever level of detail they wish and to chart the direction of additional questions. Use of extensive interview schedules is possible only with a sound knowledge of local culture. Important patterns cannot be

discerned and quantified until significant questions have been identified through key respondents, focus groups and participant observation.

Interviews are progressively embellished and eventually formalized into *survey instruments and questionnaires*. These can be used to generate data that are amenable to quantitative analysis. Interview schedules can be readily modulated for ethnopharmacologic inquiry and typically are organized around inventories of plants and diseases or other therapeutic indications. All data are cross-indexed and further elaborated to elicit all permutations of selection, preparation, use and expected outcome.

Above all, anthropologists recognize that the interactions between field researchers and their respondents are complex social processes and place great store in constructing descriptions of the 'how' and 'why' that reflect the real goings on of a population, not merely the 'ideal' (reflecting cultural norms about what should be done and how), or even the fabricated responses that are advanced in efforts to satisfy the researcher. While almost anyone asking casually about certain treatments — for wounds, for example — is likely to have a list of plants after only a short and minimal effort, more carefully crafted, and repeated, interviews extract substantially more information: they elicit those plants in order of preference on the criterion of efficacy, or availability, or some other character; they foster an understanding of the objectives of the treatments — such as hemostasis, cleansing, tissue debridement and the like; they allow us to comprehend the sources, storage, preparation and administration of those plants; and they help us to discern what the alternatives are and by which criteria these are selected.

Further, the details of context are very important, and include: social proscriptions and restrictions — for example, defining plant use by gender, age, etc.; multiple uses — for example, also in diet, as cosmetic; and other circumstances that create the situation that experience with plants may vary among individuals, and for the same person from one illness episode to another. These cultural technicalities are not superfluous, as some quick-from-the-field researchers contend. Indeed this level of detail is consonant with the goals of ethnopharmacology: in-depth and repeated interviews, in conjunction with other methods discussed here, generate precisely the sort of information

that allows us to correlate the pharmacologic actions of plants with their actual uses.

Decisions regarding plant utilization are influenced also by how individuals interpret the contexts that involve them (Alcorn, 1981). Thus, different preparations or different plants altogether may be indicated depending on what is understood to cause the symptom, or the perceived severity of the condition. Here, anthropology has been joined recently by some ethnobotanists who, citing failure to detect biological activities in the plants they investigate, also call for closer attention to context. They note that failure to account for preparatory details ignores the complex chemical interactions that obtain not only among constituents of a single plant but also among those in mixtures of plants (Bai, 1990; Onayade et al., 1990). In this way, for example, one can appreciate the logic of a medicine comprised of plants which together increase availability of bioactive compounds (e.g., the Ayurvedic composite of *Piper nigrum*, *P. longum* and *Zingiber officinalis* (Atal et al., 1981)), or whose preparation diminishes toxicity at the same time while retaining therapeutic actions (e.g., aqueous extracts of *Aconitum* spp. reduce toxicity almost 100-fold while reserving antimicrobial and antipyretic effects (Hikino et al., 1977)). Conversely, one learns as well to temper claims of efficacy when constituents have antagonistic effects: contrary to prediction based on activity of isolated constituents, neither antibacterial nor anti-inflammatory action is achieved with the Indian composite medicine 'kampoo' — *Berberis* plus *Glycyrrhiza* roots — due to precipitation of berberine by glycyrrhizin (Noguchi, 1978). In view of the growing number of such observations, ethnobotanists also have begun to emphasize that the most likely means to achieve the objectives of ethnopharmacology requires a non-random, culturally informed search for pharmacologically active plants (Labadie et al., 1989).

Lexical and semantic studies of native categories plumb the deeper recesses of meaning and substance in plant medicines. These rely on cognitive frameworks that view culture as an ideational system — a body of concepts, ideas and knowledge (contrasted to materialist views that interpret culture as an 'adaptive' set of observable behaviors that reflect a group's pragmatic adjustment to their environment). Several alternative models may shape a cognitive system and are revealed in the study of synonymy (polysemy), markedness, symbolic and other classificatory codes, and the syntax of plants and healing (Mor-

ris, 1984; Turner, 1988; Berlin, 1990). Application of an ethnoscience perspective to systems of botanical and anatomical/physiologic knowledge helps researchers to (re)frame purposeful questions during interviews about the perceptions and uses of medicinals. In the case specifically of plants, voucher samples are the critical hinge between western science and ethnographic data that record indigenous knowledge: through the lingua franca of western taxonomy, vouchers intercalate two or more systems of unshared nomenclature and, possibly, unlike classification rules.

Discourse analysis is concerned with intervals of 'naturally situated talk', and uses lexical and semantic analyses specifically in the circumstances of interview and (participant) observation (Howell and Vetter, 1985; Eastman, 1990). The kinds of discourse that are especially germane to ethnopharmacologic inquiry are the conversations that evolve as plants are collected, prepared and administered; and interchanges between the sick and healers or other provisioners of medicine. Especially provocative are dialogues that center on treatment evaluation and redirection of therapy in cases where symptom relief or other indications of healing are not forthcoming.

Content analysis of oral traditions and of text, literary and dramatic materials is another interpretive technique amenable to both qualitative and quantitative analysis (Giordano and Zuckermann, 1988; Barber, 1991; Urban, 1991). Themes and deep structures that relate to explanations of illness and therapeutic objectives, the power and other special meanings of plants, and related details are embedded in these cultural artifacts and, thus, add another level of information to ethnopharmacologic inquiry. One learns of underlying themes that explain the rationality of certain plant combinations in ways that laboratory investigations will never disclose. For example, humoral models of health are based in equilibria along such axes as hot-cold, wet-dry, sweet-bitter, *yin-yang*, and others; familiarity with those constructs better equips us to both understand and predict when and how particular plants are identified, prepared and administered*. Similarly, one uncovers the cultural significance of certain colors, textures, and organoleptic qualities that shape selection and that may or may not be related to phytochemistry. Other oral and literary texts reveal how gender and other social categories influence people's relationships to classes of plants or growing locations (Browner, 1985; Etkin, 1986, 1988b; Manderson, 1987; van Esterik, 1988; van

der Geest and Whyte, 1989; Etkin et al., 1990). These points underscore the importance of comprehending plant use in the everyday (as well as other, special) contexts within which it occurs. Ultimately, this informs how people come into contact with plant constituents — therapeutic, toxic or other.

Rapid ethnographic assessment

Given anthropologists' concern with cultural relevance, we customarily argue that the best data are generated through long-term, in-residence and longitudinal research in order to test hypotheses based on refined measures of sociocultural dynamics (Foster et al., 1978). The 'holistic' mien of anthropology defines that any phenomenon can be explained only through the interrelationships of many factors that bear on the physical, sociopolitical and cultural environments. At the same time, we are aware that this level of detail requires an investment of effort that may not be commensurate with the objectives and time frame of many researchers, including some anthropologists. That impediment can be partly offset through deployment of rapid ethnographic assessment techniques (the 'rapid rural appraisal' of development anthropology) which accommodate the special needs of researchers whose work in applied settings requires speed and product, yet still values cultural information. These rapid techniques distill the more cogent variables for a particular circumstance and are highly amenable to multidisciplinary efforts (e.g., Scrimshaw and Hurtado, 1987; Bentley et al., 1988). Related tools developed in conjunction with the World Health Organization (WHO, 1991) also offer abridged methodologies: e.g., EMIC (Explanatory Model Interview Catalogue for Ethnographic Research); ANTHROPAC, a software program that employs multidimensional scaling and cluster analysis. Speed is neither the only motivating criterion, nor the principal impact of these methodological developments: importantly, rapid assessment

*On balance, criticism has been aptly launched (Tedlock, 1987) against the reification and medicalization of such ideologies, since they do not in all cases influence day-to-day therapeutics, especially among lay persons. In other words, that an individual can specify a particular illness as hot and corresponding treatments as cold does not signify if in the real circumstances of illness that person uses additional or other criteria to identify therapy. This gives weight again to the pragmatic basis of medical behaviors that are built on empirical knowledge of plant action.

techniques demystify culture-oriented fieldwork for researchers unfamiliar with ethnographic techniques; and they render data more useful for collaborating researchers from other disciplines. All the rapid techniques combine qualitative and quantitative data to clarify how the culture of communities affects therapeutic strategies. And they are sufficiently rigorous to avoid the 'quick and dirty' expediences of which anthropologists have traditionally been (justifiably) critical.

To meet the objectives of ethnopharmacologic inquiry, a rapid assessment methodology can be applied to generate normative explanatory models. Interviews and observations should plumb the range of intracommunity variability to discern patterns of plant selection, preparation and administration. Those behavioral data finally are analyzed in light of the pharmacologic and other actions of those plants. With regard to ethnomedical and ethnobotanic data, this approach has been used with some success already in international agriculture research (e.g., Rhoades, 1986). Systematically applied, rapid assessment inquiry can accurately drive analysis toward behaviors and interpretations that are meaningful to the study community.

On a cautionary note, one should be mindful that abbreviated methodologies are effective only if embedded within a wider research project: these rapid protocols are designed primarily to streamline data collection and do less to promote analysis. Whereas proponents and critics alike contend that rapid assessments (only) forge an 'optimal ignorance', this at least improves on the methodologies that elicit plant information from only one or a few individuals and without regard to some of the basic features of local culture.

The objectives of a diverse methodology

Anthropologists who contribute to ethnopharmacology are not, then, constrained by a narrow methodological protocol. Reliance on a diverse methodology ensures not only a more varied data set but also enhanced validity — as, for example, when conclusions drawn from unstructured interviews can be cross-checked with direct observations and formal surveys. Resolution, rather than adjudication, of discrepant accounts enriches the ethnographic description (Bernard et al., 1986).

I do not mean to imply that the elaboration of rigorous and multidisciplinary field methodology is unique to anthropology. Indeed, it has been variably, and rightly, claimed by such other

disciplines as ethno- and economic botany (e.g., Holmstedt and Bruhn, 1983; Croom, 1983; De Smet and Rivier, 1989) which engage a parallel mandate for cultural detail (e.g., Labadie, 1986; Labadie et al., 1989; Cox et al., 1989; Johns et al., 1990). My point here is simply that the social sciences, anthropology prominently among them, have invested more heavily in field-constructed thick ethnographies and have evolved a more explicit set of concepts and methods in which the accuracy, validity, precision and reliability of basic cultural data play a pivotal role.

If the common denominator is culture, a set of variables that represent an abstracted belief system, the point of attention is on actual behavior as it reflects those underlying rules. This is what we attach to the pharmacologic actions of plants in order to assess their impact on human health.

Problem orientations for anthropological inquiry in ethnopharmacology

Within the broader endeavor, other research efforts should be shaped by a particular problem focus*. An otherwise theoretically neutral methodology can be problematized by structuring inquiry to various perspectives. This is accomplished by generating and testing hypotheses that ultimately allow us to bridge indigenous and western systems of knowledge. The hypothetical formulations entertained by anthropologists locate as independent variables both the pharmacologic and the symbolic import of plants. To cite a simple example, the shifting circumstances of culture make it more plausible in one location to posit that plant X is used because it has anti-inflammatory action, and in another cultural context that plant X is used because it bears red flowers, crooked limbs or other characteristics that carry currency of a symbolic nature.

Efficacy

Of the various problematics that give direction to ethnomedical study, efficacy is the organizing paradigm perhaps most central to ethnopharmacology. Here the multidisciplinary mandate for scholarship is most pronounced, where ethnographic data reveal when and how plants are used and with which specific expectations, while phytochemical, pharmacologic and clinical data

*Others, outside the social sciences, also have pointed to the value of a topical or problem focus with feasible objectives (e.g., Labadie, 1986).

help us to predict and assess physiologic outcome. For example, ethnographic data regarding expectations of therapeutic outcome suggest the most cogent experimental disease models through which to test pharmacologic action. Then, through benefit of knowledge regarding collection, confection and administration, the relevant plant parts, preparations, and combinations can be isolated for analysis. Whereas such inferences are compelling in the abstract, in fact there is little in the medical and anthropological literatures that successfully treats the efficacy of indigenous healing (Etkin, 1986, 1988a,b, 1992; Browner et al., 1988; Anderson, 1991).

Cultural anthropologists especially have been ill equipped to assess the physiologic outcome of medicines and have been generally unmindful, or ignorantly critical, of the extent to which indigenous peoples comprehend their biotic environments and manipulate botanicals to their own ends*. From the other cultural camp one hears patronizing assertions regarding the efficacy of 'time-tested' therapies (e.g., Harner, 1982). That these hyperboles no longer hold currency casts the weight of anthropological contributions firmly on that part of the efficacy equation that deals with the objectives of native therapeutics. These are embedded in the ethnographies that can discern, for example, whether a particular plant medicine is used to reduce symptoms, to cause the nosebleed that indicates spirit removal, or some combination. Significant here is that therapeutic intentions are culturally constructed, even such seemingly objective aspects as 'efficacy' (Etkin, 1988b; Haak and Hardon, 1988). This sets the stage for potentially different expectations in treating what appear to be identical physiologic disorders. An accurate ethnography may reveal that not all, or even many, disease concepts and nosologies correspond to biomedical paradigms. Thus, one cannot evaluate in the laboratory the efficacy of a plant used against swelling due to infection in the same way that one evaluates a plant used to treat swelling caused by witchcraft. Similarly, the symptom complex that biomedicine calls malaria may not be recognized by some populations as a composite, but rather as intermittent fever alone, fever plus jaundice, anemia plus hematuria or some other

permutation. Then laboratory assessments of plants used in treating one or more of those symptoms must be adjusted to reflect those variable categorizations. This casts into bolder relief still the importance of knowing the therapeutic intentions that shape plant use**.

Whereas we are confident that a thick ethnography will divulge local therapeutic models in adequate detail, we share with pharmacologists an uncertainty regarding the extrapolation from phytoconstituent analysis to the human experience (Etkin, 1988a; Romanucci-Ross and Moerman, 1988). This is to say, without parallel clinical study, we do not know how knowledge of phytochemical potential translates to the circumstances of actual plant use during illness. This pertains especially in light of the intertexture of symbolic and manifest assessments of efficacy (Romanucci-Ross and Moerman, 1988), which makes it difficult to discern how much of healing is due to some alkaloid and how much to the emblem of plant and process.

Around issues of efficacy, research strategies can be further problematized in several ways. It is logical first to deconstruct the complexity of an entire pharmacopoeia by using cultural data to focus investigation on some selected category of plants.

(A) One such subsample includes plants used in multiple contexts, such as in medicine and diet, medicine and hygiene, medicine and cosmetics, and various permutations thereof. Plants used in more than one context potentially have a more significant health impact due to increased exposure of users to pharmacologically active constituents. To date, only a small number of studies have explored multicontextual use but, significantly, have connected activity to the physiologic reality of the diseases those plants are used to treat (Reinhard et al., 1985; Johannes, 1986; Hamerschmidt, 1986; Iwu, 1986; Katz and Schall, 1986; Ekeke and Shode, 1990; Etkin, 1990, n.d.; Johns, 1990; Johns et al., 1990; Etkin and Ross, 1991a,b).

(B) Another set of plants that might be subsected for analysis includes those used in veterinary medicine. Ethnoveterinary medicine has been described as 'a peninsula on the shore of . . . local knowledge systems' (Nolan, 1989: v), em-

*Similarly, through bias in the hands of phytochemists, generic constituent or activity screens have been elaborated without regard for the therapeutic strategies employed in situ (e.g., Lopes et al., 1989; Berkan et al., 1991; Phillipson and Wright, 1991; Wagner, 1989).

**This is confounded, albeit in a smaller way, by biologically different responses among individuals to medicines and xenobiotics in general, and especially to plants. These reflect polymorphisms in drug oxidation, intestinal degradation and other circumstances that affect bioavailability and activity (Kalow et al., 1986; Niwa et al., 1991).

phasizing its relatively recent systematization for research on animal health and its virtual oversight in studies of human ethnomedicine (Morgan, 1981; Nwude and Ibrahim, 1980; Mathias-Mundy and McCorkle, 1989). Its relevance to people's health resides in the use of domestic animals for testing new plants or preparations for human therapeutics (and indirectly in the contribution of those animals to human diets). To the extent that the transposition of animal medicines to humans occurs, one might pose it among overlapping contexts of use previously noted (A).

(C) Some researchers contend that the temporal and geographic continuity in the use of medicinal plants is shaped largely by the empirical constructs of indigenous peoples (Alcorn, 1981; Etkin, 1988a). Such studies then focus on species which are used repetitively — over time and/or geographic space — as the most likely to be biologically active and efficacious (Johns et al., 1990). Historical depth is established through evidence for consistency of plant use over time in a particular area (Petkov 1986; Ortiz de Montellano, 1990). Frequency counts within regions can record repetitive use across communities and are augmented by monitoring, for example, the frequency of occurrence of a species in household gardens or market settings, its volume of trade and the consistency with which it is (has been) used in a limited number of circumstances (Bye, 1986; Trotter and Logan, 1986). These quantitative assessments serve both cross-cultural and cross-temporal comparison (e.g., Johns et al., 1990; Moerman, 1991).

(D) A fourth example for subsecting a pharmacopoeia is to focus on plants applied against a symptom or symptom set: e.g., thromboembolic disease (Beretz and Cazenave, 1991), cancers (Duke, 1986), malaria (Noster and Kraus, 1990; Weenen et al., 1991), or dental (Elvin-Lewis, 1986) and gynecological disorders (Browner and Ortiz de Montellano, 1986). Similarly, plants may be specified for study to discern certain constituents — e.g., alkaloids (Arbain et al., 1989), prostanoids (Afzal et al., 1991), peroxides (Rucker et al., 1991); or pharmacologic activities — e.g., anti-inflammatory, analgesic, or antipyretic (Lanthers et al., 1991). This fourth category has proved most problematic, because many researchers do not take care to determine whether in fact there is overlap between biomedical and other categorizations of disease. Thus, regardless that these disease- and activity-centered studies are based somehow in the knowledge of indigenous peoples,

they qualify only marginally as *ethnopharmacologic* inquiry.

Conclusion

Overall, then, anthropological approaches are human-centered and critical of the decontextualized and acultural schema that fail to portray indigenous knowledge accurately. Typically anthropologists do not seek to discover new drugs or otherwise advance biomedicine, although our work may serve that end as well. This positions us in contradistinction to those who seek to use traditional medicine as a springboard for pharmacologic investigations (e.g., Petkov, 1986; Tyler, 1988; Samuelsson, 1989; Cordell et al., 1991; Evans, 1991; Sevenet 1991), and whose implementation into laboratory investigations may be rather far removed from the specifications and expectations of local users. Whereas this approach has its own intrinsic merits, it does not link bioscientific research to traditional empirical knowledge (Labadie, 1986). Moreover, anthropologists are not interested in using biomedical criteria to 'vindicate' indigenous therapeutics, as some others see the task (e.g., Chandler, 1983; Holmstedt and Bruhn, 1983). My point is that the unique contributions of anthropology to ethnopharmacology rest with the depth to which we develop an ethnographic base that can be correlated with laboratory and clinical investigations in such a way that we comprehend contextually how people's medicinal and other actions affect their health.

By extension, this speaks to the significance of sustaining regional and global biodiversity, since locally defined uses should underpin conservation efforts at least to the same extent as externally applied standards for definition of 'important' plants. Further, this perspective makes explicit the collaborative role of local populations in such efforts. It is this latter commission that draws attention to concerns with real and intellectual property rights — the considerations that direct which and in what manner research participants ought to benefit from their respective contributions (Posey, 1990; Elisabetsky, 1991; Weniger, 1991).

An anthropological perspective can help to shape efforts in both directions: a solid ethnographic base first helps us to select and test plants in meaningful ways, and later instructs us how to communicate that information to those on whose knowledge our work is based. This offers ethnopharmacologists the ultimate intellectual

challenge – how to return research findings in a form both comprehensible and meaningful to local populations.

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A HAUSA HERBAL PHARMACOPOEIA: BIOMEDICAL EVALUATION OF COMMONLY USED PLANT MEDICINES

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Summary

Biochemical analysis of a selected sample of the Hausa (northern Nigeria) medicinal flora is presented in order to assess potential chemotherapeutic values. Laboratory investigation, supplemented by previously published phytochemical constituent analyses of pertinent taxa, suggests that a number of disorders can be effectively treated by the Hausa practitioner. The Hausa herbal pharmacopoeia is analysed first with reference to its efficacy in the treatment of oral disease. Examined subsequently are Hausa plant medicines considered to be of potential value in the treatment and/or prevention of malaria infection, with particular attention focussed on the malaria symptom complex and parasite-host cell biochemistry. Results are discussed in the context of the adaptive potential of non-Western medical systems and the significance of this aspect for medical policy development programs.

Introduction

Reflecting the prominent role that "folk" medical traditions play in human-environmental interactions, especially insofar as they impact upon worldwide problems of morbidity and mortality, indigenous medical practices have been the subject of much attention in the literature of various disciplines. To date, the investigations of indigenous medical practices have, by and large, concentrated on the sociocultural features of these systems; for example, folk attitudes regarding disease etiology and treatment; status, role, and personality of local practitioners; magico-religious significance and ritual context of certain medical treatments, and the like. An important aspect of indigenous medical systems that has received only cursory attention from the social and natural sciences is the physiological efficacy of indigenous medicines.

In recent years, there has been a heightened interest among African and other non-Western scholars in their own herbal pharmacopoeias. In many countries this reflects the general climate of intensified nationalism, with a re-emphasis on traditional institutions and practices, including medicine. While well-intentioned claims for the therapeutic value of traditional medicines have been professed from various sectors throughout the world (Kiteme, 1976; Ndeti, 1976), they are frequently based on subjective or intuitive judgements (Emmanuel, 1976; Imperato, 1977; Schultes, 1962). To date, the specificity, mode of action, and clinical efficacy of indigenous plant medicines have not been established in a manner congruent with the standards of modern pharmacognosy and pharmacology (Penso, 1977; Rowson, 1969; Swain, 1972; WHO, 1975).

The importance of empirical research on traditional plant medicines has been recently re-emphasized by the World Health Organization (WHO). In recognition of the fact that traditional healers and their pharmacopoeia constitute the basic core of primary health care in 90% of rural populations in developing countries (Ayensu, 1978), the WHO has been promoting laboratory investigations into the pharmacological and other properties of indigenous plant medicines (Penso, 1977; WHO, 1975). The research reported in this communication is consistent with these recommendations and offers a new approach for evaluating the biomedical efficacy of indigenous plant medicines.

A review of the literature reveals that as more data become available from phytochemical analyses of medicinal plants, more credibility has been given to claims of therapeutic efficacy for certain indigenous medicines. For the most part, credibility is afforded only to those medicines used in the treatment of diseases that display simple and discrete symptoms, rather than to those used in the treatment of relatively more complicated disorders that are characterized by interrelated and externally undiscernible symptom complexes (Ackerknecht, 1971; Horton, 1967; Kleinman, 1977). Reflecting this orientation is the interest generated in the discovery of antibiotic or anti-inflammatory properties in folk medicines used to treat relatively simple disorders such as wounds, epidermal infection, tooth decay, and the like (Alland, 1970; Gelfand, 1964; Harley, 1941; Parrott, 1970). One can quite rationally and easily propose therapeutic value for plants containing antibiotic principles used in the treatment of simple epidermal or dental infections. Such direct associations are not as easily discerned for complicated (multi-symptom) diseases, and medicines used in their treatment have received considerably less investigatory attention. An assumption implicit here, and one that is not necessarily justified, is that individuals not trained in scientific medicine can not devise methods to successfully treat or prevent complex diseases and that only those behaviors emically or etically perceived as therapeutic need to be considered in the evaluation of indigenous disease treatment.

While studies of relatively simple, symptom-discrete diseases are valuable, what is also important is an examination of the more complicated dis-

eases or symptom complexes and the possible efficacy of folk medicines used in their treatment. This importance derives in part from the fact that it is precisely in the prevention and treatment of these complex diseases that one often finds most competition between Western and indigenous medical systems, a fact that has far-reaching policy implications for medical development programs (Dunlop, 1974/75; Foster, 1973, 1976; Janzen, 1978; Lambo, 1971; Schwartz, 1969).

In the ensuing discussion, described first are the research setting and the source and nature of data collected on the use of indigenous medicines among members of a rural Hausa community in northern Nigeria. Following, in order to contrast different methodological approaches used in the empirical evaluation of medicinal plants, data analyses are presented from two different portions of the Hausa herbal pharmacopoeia. The first analysis addresses questions of potential efficacy for plants used in the treatment of oral disease, and is based on constituent analyses reported in the pharmacological literature. This type of analysis is consistent with the more conservative approaches to folk medicine, whereby positive or negative values are assigned on the basis of efficacy in the treatment of simple, discrete, easily recognized symptoms. The second area of inquiry is an investigation of plant medicines used in the Hausa treatment of malaria. This is, in contrast to the first type of analysis, based to a large extent on independent laboratory investigations. Moreover, considerations are not restricted to discrete symptoms, but are instead inclusive of the malaria symptom complex in its entirety.

Study setting and data

An extensive investigation of the uses and efficacies of indigenous medicines was initiated during the author's residence from May 1975 through October 1976 in a small ($n = 400$) Hausa-Fulani farming community, Kausani, located 50 km southeast of Kano City, in the Wudil District. Western scientific medicine is scarcely used by members of this community: as is characteristic of many developing areas (Foster, 1973), problems of cost, transportation, lack of familiarity, and the like dissuade villagers from availing themselves of medical facilities in Kano City. Villagers occasionally visit the government dispensary in the town of Wudil, 10 km from Kausani, where they attend a large weekly market on Friday of each week. Married women, whose mobility is greatly restricted by the Islamic proscriptions of *purdah*, virtually never attend this dispensary, although family members may secure medicines for them in their stead. Wound dressings and "fever" remedies are the treatments most frequently sought at the dispensary. The former, although well administered, is of limited utility unless individuals are instructed to cleanse wounds regularly and return to have dressings changed. For the latter, chloroquine is routinely given in single or at least limited dosages and, as such, can have little utility

for malaria infection and probably no therapeutic value for the various other (febrile) disorders for which it is administered. For both, unless individuals experience rapid reduction of symptoms, they are unlikely to return to the dispensary and turn, instead, to other sources of medical care — herbal and other indigenous medicines available in the village and from itinerant and market herbalists. The only Western medical products routinely used in the village are commercial aspirin preparations which reach even the smallest local markets through trade networks originating in the major urban centres.

As such, the indigenous system is the only significant source of medical care for the population studied and is used concurrently, and often indistinguishably, with curing practices that derive both from Islam and from an older, *Bori*, or spirit-based religion. This continued reliance on indigenous treatments, in an area where Western medicine is frequently in short supply and in any case not actively sought, provides a strong rationale for the evaluation of therapeutic and other properties of indigenous medicines.

Information regarding attitudes and beliefs relevant to disease etiology, classification, and treatment modalities was collected in order to develop a normative description of the most commonly perceived disease symptoms or symptom complexes and medical practices used in their treatment. Extensive interviews were conducted with individuals who are considered by other members of the study population, and who perceive themselves, to be most conversant in matters relevant to health and disease. Fourteen adults, five women and nine men, constitute the group of principal respondents. Included within this group is the "Queen of Bori", a woman widely recognized throughout the Wudil area as a chief herbalist, and one whose knowledge and training in plant medicines can be described as the most inclusive and broad-based. Other respondents offered a rather more specialized focus of medically relevant knowledge, for example, a local barber-surgeon and two midwives. These individuals could describe treatments used for a variety of common complaints, and several were also recognized locally as "specialists" in specific treatment modalities, for example, weaning medicines, cures for bewitchment, venereal disease remedies, and the like. Interview questions were loosely structured around: (1) a list of 637 plants which individuals described with reference to physical descriptions for each plant and any medicinal or other uses associated with it; (2) a catalogue of 808 disease names, symptom descriptions, and related terms for which respondents described commonly used indigenous treatments, including preparation procedures, approximate dosage, other components of the "recipe", repetition of applications, and alternatives for situations in which the medicine does not work. The medicinal applications of indigenous flora as reported for Kausani are to a large extent congruent with the surveys of Hausa medicinal plants reported by Adam *et al.*, (1972), Dalziel (1937), Ainslie (1937), Oliver (1960), Ayensu (1978), Hambali (1973), and Prietze (1913/14).

Samples of approximately 100 commonly used medicinal plants were collected by the author with the identificatory assistance of the chief

herbalist and one or more of her assistants. These plants were air dried in the field and sent to the United States for future laboratory investigations. For purposes of ascertaining precise botanical taxonomic nomenclature, pressed herbarium (voucher) samples accompanied each plant collected; and these are currently housed in the African collection of the Herbarium at Shaw Botanical Gardens, St. Louis, Missouri, U.S.A. The samples collected from the Hausa herbal pharmacopoeia constitute the basis for the laboratory analyses discussed below.

Oral health and medical treatment

In view of the fact that oral diseases in general (caries, mucosal inflammation, periodontal disorders, and the like) tend to have a rather discrete symptomatology, it is relatively easy to evaluate the potential efficacy of plants used in their treatment by examining such medicines for antibiotic, anti-inflammatory, and other therapeutically relevant properties. In this analysis of Hausa plant medicines, attention is directed first to those plants described by the study population as specific for the prevention and/or treatment of oral diseases. Also important for such an investigation, and evaluated next, is the application of other plant products which may have some impact on oral health. For example, plants chewed for coughs and other bronchio-congestive disorders and plants applied cosmetically to the teeth and gingival surfaces may also influence the status of oral health, although their use is not so defined by the study population. A preliminary discussion of additionally relevant data has been previously reported (Etkin, 1980).

Summarized in Table 1 are the most commonly reported elements of the Hausa herbal pharmacopoeia used in the treatment of oral disease and related disorders. Brief descriptions of preparation and application are included, as are phytochemical constituent analyses as reported in the pharmacological literature for some of the pertinent taxa.

Listed first (group A) are those plants used locally as "chewing sticks", in a manner analogous to tooth brushing: chewing sticks are used to scrub tooth, gum, and occasionally tongue surfaces and may be held in the mouth and chewed for several hours after the cleansing has commenced. The mere mechanical action of these sticks removes plaque from the teeth and acts as a gingival (gum) stimulant to promote mucosal integrity. While chewing sticks can be considered as preventives, groups B and C consist of medicines judged by the study population to be therapeutic.

Group B comprises medicines used specifically for dental caries (tooth decay), toothache, and gingival disorders such as gum inflammation, ulceration, and the like. Group C includes medicines chewed for bronchio-congestive disorders which, by nature of their relatively extended contact with the teeth and mucosal tissues, may have some impact on oral health.

For the same reason, an evaluation of plants in group D is also important. Included here are plants whose use is not emically perceived as medic-

TABLE 1

Hausa herbal medicines used in the treatment of oral diseases

Species FAMILY	Common name Hausa name	Preparation ^a	Phytochemical and other constituents ^b
A. Chewing sticks			
1. <i>Anogeissus leiocarpus</i> Marké Guill. & Perr. (<i>A. schimperi</i> Hochst) COMBRETACEAE		Peeled stem or root.	Tannins; mucilage; gum is emollient and has been official in the BPC ^c , (4:73) (6:50, 78) (9:237) (12:19)
2. <i>Azadirachta indica</i> A. Juss. (<i>Melia azadirachta</i> L.) MELIACEAE	Neem tree <i>Darbejiya</i> <i>Dogon Yaro</i>	Stem — unmod- ified or peeled.	Oil, bark, and perhaps other parts are antiseptic, anti-inflammatory, and clinically demonstrated as valuable for gingivitis; used in commercial dentifrices (see text); Ind P, (9:238, 351) (12:48) (18:745) (19:279)
3. <i>Commiphora africana</i> Engl. (<i>Balsamodendron africanum</i> A. Rich.) BURSERACEAE	African myrrh <i>Dashi</i>	Stem — unmod- ified or peeled.	The gum-resin is bdellium, an astringent disinfectant which stimulates the mucous membranes, reduces inflam- mation, and has been of- ficial in the BP, BPC, P Helv, and USP; volatile oil contains eugenol, an anaesthetic and antibiotic (see text), (4:316) (6:43, 83) (8:20) (9:262) (12:57) (14:173) (17:70) (18:152)
4. <i>Khaya senegalensis</i> A. Juss. MELIACEAE	Dry zone mahogany <i>Madachi</i>	Peeled stem or root.	Catechuic tannins; gum- resin; bitter principle, cali- cedrin, has been clinically demonstrated as antibiotic. (4:323, 325) (6:53, 93) (9: 119) (12:68) (18:745)
5. <i>Salvadora persica</i> L. SALVADORACEAE	Tooth brush tree <i>Farin Ashuwaki</i>	Peeled stem or root.	Trimethylamine acts as a gingival stimulant; silica; sulphur; chlorine; resin; ascorbic acid; antibacterial properties; commercial dentifrice (see text), (6: 56) (9:239) (12:36) (18: 926)
6. <i>Vernonia amygdalina</i> Del. COMPOSITAE	Bitter leaf <i>Shuwaka</i>	Root.	Astringent tannins; bitter principle, vernonin, is anti- septic; ascorbic acid, (2: 109) (4:421) (6:55) (8: 114) (12:90)

(continued on facing page)

TABLE 1 (continued)

Species FAMILY	Common name Hausa name	Preparation ^a	Phytochemical and other constituents ^b
B. Caries, periodontal disorders			
1. <i>Acacia arabica</i> Willd. (<i>A. nilotica</i> Del., <i>A. vera</i> Willd., <i>A. scorpioides</i> A. Chev.) (MIMOSACEAE)	Egyptian mimosa <i>Gabaruwa</i>	Gum or bark chewed or in infusion for gingival ulceration.	Tannins; gum arabic has been official in the BP, BPC, and USP as an emol- lient; closely related species contain the antibiotic ethyl gallate. (4:202) (5:201) (8:2) (9:119) (11:140) (12:43) (14:116) (17:117) (18:546)
2. <i>Anacardium occidentale</i> L. ANACARDIACEAE	Cashew <i>Kanju</i>	Nut chewed for toothache and gum disorders.	Tannins; gum-resins; contains the fungistatic agent urishiol, and cardol, an antibiotic. (4:336) (6:43, 50) (9:85) (12:18) (13:48)
3. <i>Chlorophora excelsa</i> Benth. & Hook. MORACEAE	African oak <i>Loko</i>	Sap applied to caries teeth.	Chloropherin, an antibiotic and fungicidal agent; tannins. (7:559) (9:77, 361) (12:22, 54) (14:577) (18:772)
4. <i>Citrus</i> spp. (<i>C. aurantifolia</i> Swingle, <i>C. medica</i> L., <i>C. aurantium</i> L.) RUTACEAE	Citrus <i>Lemu</i>	Fruit chewed for all gingival disorders.	High ascorbic acid content; citrin (vitamin P) promotes capillary resistance and is used as a supplement to ascorbic acid in scurvy; mucilage; gum-resin; pectin (gum-like substance); vola- tile oil. (3:38) (9:190, 237, 287) (11:377) (12:6) (14: 18, 164) (13:118) (16:55) (18:915)
5. <i>Daniellia oliveri</i> Hutch. & Dalz. (<i>Pardaniellia oliveri</i> Rolfe) CAESALPINIACEAE	African copaiba balsam <i>Maje</i>	Gum applied for toothache.	Substitute for copaiba balsam which was formerly in the BP and USP and is now used chiefly as a filling in dental practice (BPC); resin; volatile oil. (4:186) (6:59) (8:88) (9:235) (12: 24) (14:172) (18:593)
6. <i>Diospyros mespiliiformis</i> Hochst. EBENACEAE	West African ebony <i>Kanya</i>	Fruit and leaves chewed or ap- plied in infusion for gingival irrita- tion and tooth- ache.	Contains plumbagin, an antibiotic with antihemor- rhagic properties; high fluoride content; tannins. (12:25) (13:53) (14:806) (15:1187) (18:389)

(continued overleaf)

TABLE 1 (continued)

Species FAMILY	Common name <i>Hausa name</i>	Preparation ^a	Phytochemical and other constituents ^b
7. <i>Eugenia caryophyllata</i> Thunb. MYRTACEAE	Clove <i>Kanumfari</i>	Dry flower buds (cloves) chewed for toothache.	Volatile oil contains eugenol, a local anaesthetic and antibiotic (see text); tannins. (5:180) (9:249) (11:367) (12:7) (13:104) (14:169)
8. <i>Euphorbia balsamifera</i> Ait. EUPHORBIACEAE	Balsam spurge <i>Ayyara</i>	Stem sap for gingival irritation and toothache.	Contains gum-resin and a counter-irritant, euphorbon. (5:233) (12:26) (14:191)
9. <i>Fagara xanthoxyloides</i> Lam. (<i>Xanthoxylem senegalense</i> D.C.) RUTACEAE	Candlewood <i>Fasakwari</i>	Fruit chewed for gingival irritation.	Contains artarine, an alkaloid with antibacterial and antiparasitic activity; clinically demonstrated anticariogenic activity; tannins; resin; volatile oil. (6:51, 57) (9:237, 243) (14:513)
10. <i>Lepidum sativum</i> L. CRUCIFERAE	Garden cress <i>Algarif</i>	Seeds chewed for toothache.	Contains a benzyl-sulphur volatile oil which is active against bacteria and fungi; iodine. (4:24) (6:117) (13:291) (18:332)
11. <i>Moringa pterygosperma</i> Gaertn. (<i>M. oleifera</i> Lam.) MORINGACEAE	Horseradish tree <i>Zogali</i>	Root chewed for gingival ulcers.	Pterygospermin, active against a broad spectrum of bacteria and fungi; anthonin, another antibacterial; spirochin is antibacterial, analgesic, and promotes healing; emollient gum resins. (4:23) (6:55) (9:361) (11:143) (12:32) (18:781)
12. <i>Ocimum viride</i> Willd. and <i>O. americanum</i> L. LABIATAE	American basil <i>Daddoya</i> <i>Daddoya ta Gida</i>	Chewed for all tooth and gingival disorders.	Essential oils contain thymol an antibacterial and antiparasitic agent, and eugenol which has antibiotic and anaesthetic properties (see text); methylcinnamate is bactericidal. (1:65) (4:462) (6:57) (7:559) (9:370) (11:278) (12:32, 75) (14:583) (17:51) (18:524)
13. <i>Ricinus communis</i> L. EUPHORBIACEAE	Castor oil plant <i>Zurman</i>	Root extract for mouthwash and toothache.	Contains undecylenic acid, which is emollient and fungistatic and has been official in the past in the BP, P Helv, Ind P, and USP; antibacterial properties. (3:932) (6:69) (7:561) (11:193) (12:81) (15:34) (18:428)

(continued on facing page)

TABLE 1 (continued)

Species FAMILY	Common name <i>Hausa name</i>	Preparation ^a	Phytochemical and other constituents ^b
14. <i>Zingiber officinale</i> Rosc. ZINGIBERACEAE	Ginger <i>Chittar Aho</i>	Rhizome chewed for toothache.	Essential oil contains the antiseptic principle cineol, official in the Ind P, BP, and formerly in the USP as a carminative, stimulant and flavoring. (5:181) (11: 360) (12:10) (14:198) (15:638) (16:172) (18: 1063)
C. Bronchio-congestive disorders			
1. <i>Acacia campylacantha</i> Hochst. MIMOSACEAE	African catechu tree <i>Farchan Shafo</i>	Branch chewed for sore throat.	Tannins; gum; has been of- ficial in the BPC as an as- tringent. (1:2) (4:204) (5: 201) (6:50) (12:43) (18:549)
2. <i>Allium sativum</i> L. LILIACEAE	Garlic <i>Tafannuwa</i>	Chewed for colds and cough.	Volatile oil contains allicin which demonstrates strong antibacterial activity; salivine accelerates healing of wounds; fungicidal and antiparasitic properties; the antibiotic sulphur oil has been official in the Ind P and P Fr. (5:182) (9:123) (12:45) (14:175) (16:172) (18:1140)
3. <i>Alysicarpus vaginalis</i> D.C. and <i>A. rugosus</i> D.C. PAPILIONACEAE	<i>Gadagi</i>	Chewed for cough.	Tannins; gum-mucilage. (6:77) (12:18) (18:558)
4. <i>Anogeissus leiocarpus</i> Guill. & Perr. COMBRETACEAE	<i>Marke</i>	Bark chewed for cough.	Tannins; mucilage; gum is emollient and has been of- ficial in the BPC. (4:73) (6:50, 78) (9:237) (12:19)
5. <i>Capsicum annum</i> L. and <i>C. frutescens</i> L. SOLANACEAE	Capsicum pepper Shrubby capsicums <i>Barkono</i>	Chewed for colds and cough.	Contains the essential oil capsaicin which is official in some European pharma- copoeias and formerly in the USP as a counter-ir- ritant; high ascorbic acid content; vitamin A; vitamin E; mild antibacterial activ- ity. (4:427) (6:62) (9:85) (11:369) (12:51) (14:191) (16:173)

(continued overleaf)

TABLE 1 (continued)

Species FAMILY	Common name <i>Hausa name</i>	Preparation ^a	Phytochemical and other constituents ^b
6. <i>Cassia tora</i> L. CAESALPINIACEAE	Foetid cassia <i>Tafasa</i>	Leaves chewed for cough, pneumonia.	Contains chrysarobin, an antiparasitic principle of- ficial in European pharma- copoeias and formerly in the USP for infectious skin diseases; tannins. (5:22:210) (6:50) (10:576) (11:364) (12:21) (14:192)
7. <i>Eugenia caryophyllata</i> Thunb. MYRTACEAE	Clove <i>Kanumfari</i>	Dry flower buds (cloves) chewed for all bronchial dis- orders.	Volatile oil contains eugenol a local anaesthetic and anti- biotic (see text); tannins. (5:180) (9:249) (11:367) (12:7) (13:104) (14:169)
8. <i>Euphorbia hirta</i> L. and <i>E. convul- vuloides</i> Hochst. EUPHORBIACEAE	Asthma herb <i>Nonan Kurchiya</i>	Chewed for coughs.	Extracts used in asthma and bronchial inflammation and have been official in the BPC; antibiotic activity; tannins. (12:63) (13:140) (17:24) (18:408)
D. Stimulants, cosmetics			
1. <i>Argemone mexicana</i> L. PAPAVERACEAE	Mexican poppy <i>Kwarko</i>	Flower and fruit for stain- ing teeth.	Artarine, berberine, and protopine have antibacterial, antiparasitic, anti-inflam- matory, and pain depres- sant activities. (5:226) (9:243) (12:47) (17:21) (18:815)
2. <i>Bauhinia reticulata</i> D.C. and <i>B. thon- ningii</i> Schum. CAESALPINIACEAE	Camel's foot <i>Kargo</i>	Bark chewed to stain teeth red.	Tannins. (6:50) (9:236) (18:560)
3. <i>Cola acuminata</i> Schott & Endl. and <i>C. nitida</i> A. Chev. STERCULIACEAE	Kola nut <i>Goro</i>	Nut chewed as stimulant and to allay thirst and hunger.	High caffeine; tannins; essential oil. (2:255) (4: 100) (5:111) (6:55) (7:620) (9:17) (12:6) (14:241) (16:168) (18:1013)
4. <i>Garcinia kola</i> Heckel GUTTIFERAE	False kola <i>Ci da Goro</i>	Seed chewed as kola substitute.	Tannins; may contain the antibacterials morellin and guttiferin. (4:91) (6: 50) (9:361)

(continued on facing page)

TABLE 1 (continued)

Species FAMILY	Common name <i>Hausa name</i>	Preparation ^a	Phytochemical and other constituents ^b
5. <i>Nicotiniana tabacum</i> L. SOLANACEAE	Tobacco <i>Taba</i>	Flowers chewed to impart red color to teeth.	Nicotine; has been used in veterinary medicine as an antiparasitic (B Vet C). (4:431) (9:388) (12:8) (18:963)

^aSome of these plants are also used in other medicines whose applications are not discussed here.

^bSources for these data are cited parenthetically at the end of each description, with the first number designating the reference work, and subsequent numbers indicating pagination: (1) Ainslie, 1937; (2) Ayensu, 1978; (3) Bowman *et al.*, 1968; (4) Dalziel, 1937; (5) Evers, 1926; (6) Githens, 1949; (7) Goth, 1970; (8) Lely, 1925; (9) Lewis and Elvin-Lewis, 1977; (10) Millspaugh, 1892; (11) Morton, 1977; (12) Oliver, 1960; (13) Robinson, 1967; (14) Sollmann, 1922; (15) Stedman, 1961; (16) Thomson, 1978; (17) UNESCO, 1960; (18) Watt and Breyer-Brandwijk, 1962; (19) Wheelwright, 1935.

^cAbbreviations: BP, British Pharmacopoeia; BPC, British Pharmaceutical Codex; B Vet C, British Veterinary Codex; Ind P, Indian Pharmacopoeia; Ind PC, Indian Pharmaceutical Codex; USP, US Pharmacopoeia; P Helv, Swiss Pharmacopoeia; P Fr, French Pharmacopoeia. References used for compilation of these data specify no particular edition or year of publication for these codices. Many of the plant species are no longer included in these compendia (Morton, 1977), and are so indicated here as "having been official".

inal, but rather as cosmetic or stimulant. Nonetheless, any pharmacologically active principles present in these plants may be significant for oral health, insofar as their use dictates prolonged contact with the teeth and oral mucosa.

A general appraisal of the pharmacologically active constituents in Hausa oral medicines reveals that most of them contain tannins. These compounds have an astringent action afforded by their ability to precipitate proteins and to constrict small blood vessels. Thus, they have therapeutic value in arresting haemorrhage and as applications to damaged tissues such as in wounds, inflammations, and ulcers which are then protected with an impervious coating which prevents external irritation and facilitates healing. Moreover, tannins demonstrate antibiotic activity by coagulating bacterial protoplasm, thereby destroying the micro-organisms (Bowman *et al.*, 1968; Githens, 1949; Oliver, 1960; Sollmann, 1922). In oral medicine, then, tannin-containing plants can be expected to reduce the bacterial flora and, perhaps, in this way retard cariogenic and inflammatory processes. They could serve further to arrest bleeding of gingival ulcers and soothe, protect, and promote healing of the oral mucosa. Superficial precipitation affords the characteristic astringency of tannins that makes them readily recognizable by taste, a fact that might be important in the indigenous selection of oral medicines.

Gum-resins and mucilages, also found in some of these oral medicines, can serve as emollients, soothing the mucous membranes of the mouth and throat. By forming an impervious coating, they reduce the action of chemical, mechanical, or bacterial irritants on the oral mucosa and, thus, diminish pain and inflammation and protect the affected area against additional insult. They may also coat the tooth surface and protect the outer, enamel tooth layer against decay (Sollmann, 1922; Bowman *et al.*, 1968; Lewis and Elvin-Lewis, 1977).

Volatile or essential oils are another class of pharmacologically active constituents found in a large proportion of the Hausa plants used in oral medicine. Many volatile oils have antibacterial activity and would be expected to be of therapeutic value in oral infections. Various of these oils also have value for inflammatory conditions by nature of their mild anaesthetic action. This is particularly true for those that act as counter-irritants — agents that produce nervous stimulation at the surface and, in so doing, reduce deep-seated inflammatory pain by supplanting, in the spinal nerves, transmission of the original pain sensation (Stedman, 1961; Oliver, 1960; Githens, 1949; Sollmann, 1922). In addition to the therapeutically valuable action of volatile oils in oral disease, it should also be noted that because these oils act in part by local irritation, they are potentially injurious. However, the quantity taken is in most cases too small for any tissue damage to accrue (Evers, 1926; Lewis and Elvin-Lewis, 1977).

More significantly, a number of the Hausa plant medicines contain specific phytochemical constituents that have been clinically demonstrated to be therapeutically efficacious in tooth, gingival, and related disorders. For example, *Azadirachta indica*, the second entry under chewing sticks in group A, has antiseptic and anti-inflammatory properties, with noted efficacy in the treatment of gingivitis (gum inflammation). Extracts of this plant are used in the manufacture of two commercial dentifrices: Neem toothpaste of Calcutta Chemical Company Ltd., Calcutta, India; Nimodent toothpowder of Hamdard Company Ltd., Karachi, Pakistan. The specific formulations of these products have not been disclosed (Lewis and Elvin-Lewis, 1977).

The gum-resin of *Commiphora africana* has in the past been included in the British, Swiss, and US Pharmacopoeias as a mouthwash with disinfectant and mucosal-stimulating properties (Oliver, 1960; Sollmann, 1922). This plant also contains eugenol, a topical antibiotic and anaesthetic used chiefly in dentistry, formerly included in the US Pharmacopoeia and still official in several European pharmacopoeias (Morton, 1977; Sollmann, 1922; Watt and Breyer-Brandwijk, 1962).

Salvadora persica has been quite extensively analysed, probably a reflection of its many applications observed cross-culturally and the inclusion of its stem and/or root in a British commercial dentifrice — Sarakan toothpaste manufactured by Sarakan Ltd., Beckenham, Great Britain — a precise formulation for which has not been reported (Lewis and Elvin-Lewis, 1977). Antibacterial activity for this plant might be attributed to its containing sulphur and chlorine, the latter also imparting dentifrice properties to assist

in the removal of tartar and other stains from teeth. Silica, which also occurs in this plant, may act as an abrasive and serve the same cleansing function. The presence of trimethylamine can be expected to act as a gingival stimulant to promote healing. The high ascorbic acid (vitamin C) content also would be valuable in effecting mucosal integrity (Lewis and Elvin-Lewis, 1977; Oliver, 1960); however, since prolonged drying and storage deplete effective concentrations of this vitamin (Davidson and Passmore, 1966), its salubrious effects would probably not be realized unless the plant materials were used in a relatively fresh state.

The antibiotics calicedrin and vernonin have been isolated from *Khaya senegalensis* and *Vernonia amygdalina*, respectively (Githens, 1949; Watt and Breyer-Brandwijk, 1962; Oliver, 1960). Both species also contain tannins (Dalziel, 1937; Lewis and Elvin-Lewis, 1977; Oliver, 1960), and the latter relatively high concentrations of ascorbic acid (Ayensu, 1978) which would be of value if chewing sticks were prepared from fresh plant materials.

Among plants used in the treatment of caries and periodontal disorders in group B, in addition to the more generalized benefits afforded by constituents such as tannins, gum-resins, and volatile oils, several specific, clinically verified therapeutic constituents have also been reported. The antibiotics ethyl gallate, urishiol, cardol, chloropherin, and plumbagin have been isolated from *Acacia arabica*, *Anacardium occidentale*, *Chlorophora excelsa*, and *Diospyros mespiliformis*. Also of interest in *Diospyros* is the observed high fluoride content which would be of value in oral health, insofar as it contributes to tooth enamel development and integrity; it also exerts anticariogenic effects by inhibiting enzyme activity in (cariogenic) streptococcal bacteria. Further, the antihaemorrhagic effects of plumbagin would make this species important in ameliorating gingival ulceration with attendant bleeding. The compound eugenol has been described above and occurs also among plants of group B in *Eugenia caryophyllata* and *Ocimum viride*. The latter also contains the antibacterial and antiparasitic principle thymol. Additional antibacterial, fungicidal, and antiparasitic factors are indicated for other plant species of group B (consult entries in Table 1 for references).

In group C, plants used in the treatment of coughs, colds, and other bronchio-congestive disorders, a relatively high ascorbic acid content is noted for *Capsicum annum*, *C. Frutescens*, and *Cassia tora* (Morton, 1977; Oliver, 1960), with the potential therapeutic value for oral health dependent upon the relative freshness of plant materials, as discussed above. Extracts of *Allium sativum* are active against a broad spectrum of bacteria and fungi and are also effective in stimulating the regeneration of damaged mucosal tissue to promote the healing process in wounds and other lesions (Oliver, 1960; Robinson, 1967; Thomson, 1978; Watt and Breyer-Brandwijk, 1962). These properties have long been recognized by European folk practitioners and by Western scientific medicine (Lewis and Elvin-Lewis, 1977; Thomson, 1978; Wheelwright, 1935). Other antibiotics from this group

include chrysarobin in *Cassia tora*, a weak antibacterial agent in *Capsicum annum*, and eugenol in *Eugenia caryophyllata* (discussed above) (Evers, 1926; Morton, 1977; Oliver, 1960; Thomson, 1978).

In group D, among plants applied for stimulant or cosmetic purposes, antiparasitic activity has been reported for *Nicotiniana tabacum*. While tobacco flowers contain the lowest concentration of nicotine, relative to other parts of the plant (Watt and Breyer-Brandwijk, 1962), and are in any case not generally used in quantities or frequencies sufficient to jeopardize health, the negative indications of nicotine should, nonetheless, not go unnoticed. Other antibiotic and antiparasitic constituents have also been isolated from *Garcinia kola* and *Argemone mexicana*. The principles responsible for this activity in *Argemone* are in large doses moderately toxic, insofar as they may exert a depressive influence on the heart and cardiovascular system. However, as with *Nicotiniana*, above, these principles are generally not ingested in quantities sufficient to adversely affect health (Lewis and Elvin-Lewis, 1977; Oliver, 1960; UNESCO, 1960; Watt and Breyer-Brandwijk, 1962).

In view of the occurrence of various pharmacologically active constituents in some of the Hausa plant medicines, it appears that a number of them may be of therapeutic value in the treatment of certain oral diseases. This proposed efficacy is consistent with the observations of Elvin-Lewis (1980) and co-workers (1974) who examined chewing stick use and oral health among various populations throughout Africa and the Indian sub-continent. Their data suggest that in certain populations the relatively high standards of oral health, as determined by clinical dental examinations, can be at least partially attributed to chewing stick use. Plants which compose that group of commonly used chewing sticks with pharmacologically active constituents in other studies (Elvin-Lewis, 1980; Etkin, 1980) are represented within the varieties of Hausa chewing sticks and related medicines discussed in this context above.

This analysis of Hausa oral medicines was directed towards establishing the presence of specific phytochemical constituents with known pharmacological value in the treatment of simple, discrete symptoms. By contrast, our examination of Hausa antimalarials has taken a different direction, in that the empirical evaluation of these plant medicines can account for potential efficacy in the treatment of symptom-complex disorders and is based on independent laboratory investigations, as outlined below.

Hausa antimalarials

Malaria infection continues to be an important health problem for many areas of the world, including the African savanna, where attempts to eradicate the disease have been generally unsuccessful. This is due in large part to the increasing frequency of resistance among malaria parasites to chloroquine and other drugs routinely used in antimalarial therapy

(Imperato, 1977). In light of this, the examination of indigenous anti-malarials has value not only for describing how a population copes with disease, but also for insights such studies may provide for malaria therapy in general.

Pharmacological analyses of indigenous antimalarial medicines, as reported in the literature, have for the most part considered only those plants described specifically for the treatment of the malaria symptom complex in its entirety. Attention has apparently not been directed toward those plants used for single or related symptoms, for other diseases, or for emically unrelated purposes such as nutrition, hygiene, and cosmetic application. Most of these pharmacological investigations can be described as constituent analyses designed to detect the presence of quinine-like alkaloids or compounds that mimic the structure, and ostensibly the activity, of other synthetic antimalarial drugs (Bowman *et al.*, 1968; Goth, 1970; Popp *et al.*, 1968). Since no such substances have been reported for plants used in the Hausa treatment of malaria (Ekong, 1968; El-Said *et al.*, 1968; Malcolm and Sofowora, 1969; Spencer *et al.*, 1947), we directed our analysis towards laboratory examination of other pertinent biochemical parameters. The present discussion is offered to describe both the rationale and the specific methods used in assessing the potential therapeutic value of antimalarial plant medicines.

The plants whose analysis is described here are the more common Hausa medicines used in the treatment of one or more components of the malaria symptom complex. These components include the periodic fevers that characterize malaria infection, as well as more subtle indicators such as spleno-hepatomegaly, haemoglobinuria, jaundice, and anaemia. By accounting for medicines used to treat the full range of symptoms (both singly and in any combination), one can approach a more comprehensive account of indigenous plants that may affect the course of malaria infection than one could achieve if one were to simply limit analysis to medicines used when all symptoms appear together to indicate what Western medicine designates as malaria, a disease symptom "package" which indigenous practitioners may not necessarily recognize as a compound entity.

As a first line of inquiry, we elected to assess the capacity of these medicines to alter the "redox", or oxidation-reduction, status of red blood cells. Oxidation-reduction describes coupled reaction sequences that occur as part of regular metabolic processes in such a way that whenever one compound loses electrons or hydrogen (H) atoms to become oxidized, another gains these particles (or H atoms) to become reduced: compound A-H is oxidized to A-, while compound B is reduced to B-H. The significance of this particular aspect of red cell metabolism in the course of malaria infection has been previously elucidated in our research on parasite and host cell biochemistry during malaria infection (Etkin, 1975; Etkin and Eaton, 1975), and is summarized briefly here.

Examples of redox reactions important in red blood cell metabolism (and, thus, relevant to studies of malaria, the parasitic agent of which infects

red cells) are: (1) conversion of haemoglobin to an oxidized form, methaemoglobin; (2) conversion of the (reduced) enzyme cofactors nicotinamide adenine dinucleotide (NADH) and nicotinamide adenine dinucleotide phosphate (NADPH) to their oxidized counterparts, NAD and NADP; (3) conversion of the compound glutathione (GSH) to its oxidized counterpart (GS-SG). An appropriate redox balance must be maintained in order to ensure red cell integrity and proper metabolic functioning. Under conditions where excess oxidation occurs and cannot be compensated, a variety of damaging effects will ensue that lead to lysis (destruction) of the red cell. Excess and potentially damaging oxidation is indicated when: methaemoglobin levels increase, GSH concentrations decrease, or titres of NAD and NADP are high relative to their reduced counterparts, NADH and NADPH.

In the course of monitoring red cell parameters such as these, we noted increased levels of red cell oxidation attendant upon plasmodial infection [see Etkin and Eaton (1975) for full discussion], observations which are consistent with other reports in the literature of GSH depletion during malaria infection (Fletcher and Maeraith, 1970; George and Pollack, 1964). Various studies combine to suggest that while plasmodial parasites themselves appear to be responsible for generating oxidants, excessive oxidation may in the long run be detrimental to continued and successful malaria infection.

We proposed that the increased oxidation during malaria infection might explain the biochemical basis for the protection against fulminant malaria afforded by some inherited deficiencies of glucose-6-phosphate dehydrogenase (G-6-PD). G-6-PD is an enzyme responsible for catalyzing the first of a series of reactions that generate reducing compounds (NADH, NADPH, GSH) necessary for preventing or repairing oxidant damage. Because a deficiency of this enzyme results in an insufficient production of reducing compounds, G-6-PD deficient red cells would be relatively intolerant of the oxidation associated with malaria infection. Cumulative oxidant damage to malaria-infected, enzyme-deficient red cells would lead to the destruction of both the host cell and the developing parasite, with a subsequent curtailment of the infection (Etkin, 1975; Etkin and Eaton, 1975).

Eaton *et al.* (1976) proposed that the same phenomenon may occur in normal red cells rendered oxidant-sensitive by the imposition of vitamin E deficiency. (Because vitamin E is an antioxidant, its deficiency leads to oxidant overload, resulting in red blood cells that are, with respect to redox status, metabolically analogous to those with G-6-PD deficiency.) Their work with malaria infection in vitamin E deficient mice demonstrated that deficient animals were more resistant to plasmodial infection. Moreover, when vitamin E deficient animals were later resupplemented, malaria susceptibility was restored.

A possibly related phenomenon was observed among undernourished nomadic populations in sub-Saharan Africa whose diet is normally low in vitamin E. These groups were observed to be relatively resistant to severe

malaria infection; and when their diets were supplemented with grain, an excellent source of vitamin E, recrudescence of previously undetectable malaria infections occurred (Murray *et al.*, 1976). This can perhaps be partially explained by the same phenomenon — that is, elevated intracellular oxidation due to vitamin E deficiency suppresses malaria infection (Eaton *et al.*, 1976).

Such reasoning may also explain the mode of action of a number of commercial antimalarial drugs that act on the endoerythrocytic form of the parasite and that are also known to generate oxidants (Bowman *et al.*, 1968; Cohen and Hochstein, 1965).

These various observations combine to elucidate the clinical significance of redox perturbations during malaria infection. It appears, on the basis of the foregoing, that the imposition of substantial oxidant stress by a variety of endogenous or exogenous factors can be of therapeutic value in malaria infection.

In light of this, we have undertaken experiments to determine the oxidizing potential of a number of Hausa antimalarials. We suggest that plants which can raise levels of intracellular oxidation may be effective in malaria therapy. This could occur by promoting oxidant damage and subsequent lysis of infected red cells, to release immature parasite forms incapable of continuing the infection. To our knowledge, no other investigations of indigenous pharmacopoeias have examined this parameter; and this offers, we believe, a unique and important approach which can be integrated with other methods in a comprehensive evaluation of plants used by indigenous populations.

Laboratory methods and results

Our first set of experiments was designed to estimate the capacity of Hausa antimalarials to generate methaemoglobin (the oxidized form of haemoglobin) *in vitro*. Extracts were prepared from macerated plant materials in solutions of isotonic saline and neutralized to physiological pH. Normal red cell haemolysates in dilute haemoglobin suspensions were incubated at 37 °C in equivolume ratios with these extracts, and methaemoglobin levels were determined after two hours' incubation. Control samples accumulated no significant amount of methaemoglobin, with final concentrations at a predictable 0.5% of total haemoglobin.

Data are summarized in Table 2, with two-hour methaemoglobin concentrations expressed as percentages of sample 11, the only one in which all haemoglobin had been oxidized to methaemoglobin at the end of the incubation period. These data suggest the presence of oxidizing agents in these medicinal plants and indicate the relative capacity of each to generate methaemoglobin.

As a second measure of oxidizing potential, we examined these plants to determine their capacity for oxidizing glutathione (GSH). (Oxidation of

TABLE 2

Methaemoglobin generation

Sample	Plant part	Percentage of sample 11
1. <i>Acacia arabica</i>	Root	56
2. <i>Azadirachta indica</i>	Leaf	42
3. <i>A. indica</i>	Bark	9
4. <i>A. indica</i>	Root	7
5. <i>Cassia occidentalis</i>	Root	78
6. <i>C. occidentalis</i>	Leaf	68
7. <i>Cassia tora</i>	Leaf	35
8. <i>C. tora</i>	Root	29
9. <i>Cochlospermum tinctorium</i>	Root	51
10. <i>Gulera senegalensis</i>	Root	47
11. <i>G. senegalensis</i>	Leaf	100
12. <i>Securidaca longipedunculata</i>	Root	29
C. Control		0.5%

TABLE 3

Glutathione (GSH) stability (values are expressed as mM glutathione)

Sample	0 min	30 min	60 min	120 min
1	2.0	1.3	0.9	0.2
2	2.0	1.2	0.7	0.1
3	2.0	1.7	1.6	1.4
4	2.0	1.8	1.7	1.8
5	2.0	1.9	1.7	1.5
6	2.0	1.9	1.6	1.0
7	2.0	0.4	0.4	0.1
8	2.0	1.5	1.3	0.9
9	2.0	1.8	1.7	1.2
10	2.0	1.8	1.7	1.5
11	2.0	0.5	0.1	0.1
12	2.0	1.8	1.5	1.7
C	2.0	1.9	1.9	1.9

GSH to GS-SG is indicated by diminution of GSH concentrations over time.) Preparation of extracts and haemolysates proceeded as for the methaemoglobin studies. Reduced glutathione (GSH) was added to the haemolysates and combined with plant extracts in an equivolume ratio, so that the starting GSH concentration for all samples was 2.0 millimolar (mM). Samples were incubated for two hours at 37 °C, and residual GSH was measured at 30, 60, and 120 minutes. Results are summarized in Table 3, with sample numbers corresponding to plants in Table 2, and with residual GSH expressed in millimolar concentrations. Control samples showed virtually no change in GSH concentrations, with final two-hour determinations between 1.9 and 2.0 mM.

TABLE 4

Preincubation of infected red cells with plant extracts

Sample	Plant part	Parasitemia, day 7 (%)
1. <i>Acacia arabica</i>	Root	0
2. <i>Azadirachta indica</i>	Leaf	0
7. <i>Cassia tora</i>	Leaf	83
11. <i>Guiera senegalensis</i>	Leaf	1
C. Controls		87

On the basis of both methaemoglobin generation and GSH depletion studies, it appears that some of the Hausa antimalarials have significant *in vitro* oxidant generating capacity. The mere presence of oxidants in these plants does not, of course, demonstrate their efficacy as antimalarials. However, these preliminary data did suggest that some of the plants might have therapeutic value, a possibility we considered worthy of further examination. Therapeutic value could come in the form of increasing intracellular oxidation, thereby making it likely that malaria-infected red cells would succumb to oxidant stress and be destroyed before parasites had a chance to reach maturity.

In light of these results, we are continuing analysis of plants whose extracts demonstrated the highest *in vitro* oxidizing activity on haemoglobin and GSH, in order to examine their effects *in vivo*. Studies have been designed to examine the therapeutic value of these medicinal plants in an analogue of human malaria, *Plasmodium berghei* infection in mice.

Malaria infection in the laboratory is routinely passed by injecting blood from a heavily infected animal into normal, healthy ones. Our next series of experiments interrupted this process with an incubation phase, in order to expose parasites to the medicinal plant extracts. Malaria-infected red cells were incubated with neutralized extracts from plants numbered 1, 2, 7, and 11 (*cf.* Table 2), then injected into healthy animals in order to monitor any effects on the normal course of infection. Specifically, we measured the time required for the infection to reach patency and the time of death, these being standard evaluations used in testing antimalarial drugs (Aviado, 1969). As summarized in Table 4, after seven days, mice injected with parasites exposed to samples 1 and 2 were not infected; those injected with parasites exposed to sample 11 sustained very low infections; while those injected with parasites exposed to sample 7 mimicked controls (*i.e.* showed no antimalarial activity), with rates of parasitemia in excess of 80%.

These preliminary studies lend support to, although cannot yet confirm, our proposal that a number of Hausa medicines have some therapeutic value in the treatment of malaria infection. The efficacy of these plants in malaria prevention and therapy can be neither refuted nor established until such medicines are subjected to more extensive investigation and eventually to clinical trial with human infections. The most evincing tests, and those

that provide avenues for future investigation, would include more sensitive analyses that: first, can fractionate the specific constituents responsible for the *in vitro* oxidations reported here; and second, can determine whether the ingestion of these oxidizing plants effectively raises red cell oxidation to levels that can interfere with malaria parasite development. Our investigations continue along these lines.

Discussion and conclusions

The anthropological literature is replete with examples in which Western and indigenous medical systems are juxtaposed in a competitive and only marginally effective manner [for examples, see Foster (1976) and Landy (1977)]. Yet there are cases too, and India and China provide perhaps the best examples (Leslie, 1977), in which two such medical systems co-exist to offer the best of both to the health care consumer, which is to suggest that the therapeutic values of Western-scientific and indigenous medical systems are not mutually exclusive. Nonetheless, although the health benefits of Western medical treatment are generally considered to have been amply demonstrated, the efficacy of indigenous therapies remains virtually unexplored. While few would deny the psychosocially ameliorative advantage offered by indigenous practitioners (Ademuwagun, 1974/75; Jelliffe and Bennett, 1960; Kleinman, 1977), the same confidence has not been afforded their herbal medicines.

A full recognition and proper evaluation of indigenous pharmacopoeias is a necessary step in solving worldwide problems of morbidity and mortality. In view of this, a specific goal of the WHO program for the promotion and utilization of medicinal plants has been to advance a coordinated international health care effort through which Western medical personnel would be encouraged not only to provide more scientific training for traditional healers, but also to examine the work of these practitioners and to analyse critically the properties of their herbal pharmacopoeias (Penso, 1977; WHO, 1975).

Phytochemical constituent analyses of indigenous medicines can assist in identifying those components that have positive therapeutic value and which should, then, remain in use, particularly where Western medicines are either not available or occur only in short supply. Of equal importance is the identification of any toxic elements or injurious practices whose use should be actively discouraged.

The study of indigenous medicines reported here offers a biomedical evaluation of some of the commonly used plants from the Hausa herbal pharmacopoeia. In order to contrast different methodological approaches used in the empirical evaluation of medicinal plants, data analyses were presented from two different portions of this pharmacopoeia. The first analysis addressed questions of potential efficacy for plants used in the treatment of oral disease. This type of investigation is consistent with the

more conservative approaches to indigenous medicines in that it is based on constituent analyses reported in the pharmacological literature and, as such, can serve to identify specific phytochemical agents (antibacterials, emollients, and the like) with recognized pharmacological value in the treatment of relatively simple, discrete symptoms.

Attention was then directed to a biomedical evaluation of Hausa medicines used in the treatment of malaria infection. Data suggest that some of these plants — those that appear to have the capacity to increase levels of intracellular oxidation and, in this way, interfere with parasite development — may have therapeutic value in the prevention and/or treatment of this disease. This evaluation of Hausa antimalarials is to a large extent based on independent laboratory investigations, the rationale and methodological approaches for which have been described, and can be of value in the assessment of therapeutically relevant aspects of medicines used for a variety of symptoms.

Investigation of the efficacy of an indigenous pharmacopoeia in a northern Nigerian context contributes, in a more general way, to our understanding of the ways in which the resources of traditional and Western medical systems can be successfully integrated without jeopardizing the quality of health care delivery.

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