



ETHNOPHARMACOLOGY: AN OUTLOOK ON TRADITIONAL MEDICINE AND GLOBALIZATION IN DRUG DISCOVERY

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ABSTRACT

Ethnopharmacology is a highly varied approach to drug discovery which includes the observations, description, and experimental investigation of indigenous drugs and their biological activities contributing to the discovery of natural products with biological activity. Our country is an ancient heritage of various traditional medicines history shows missionaries in different colonies initially used pharmacologically active plants and till now about half of the drugs approved were based on natural products. Traditional medicines are often complex herbal mixtures and multiple compounds are extracted providing a poly-pharmacological approach to drug discovery this approach changes the concept of one disease-one target-one drug. Indian Materia-medica has abundant information on medicinal plants and also has information regarding folk traditions and their therapeutic importance. With the global commercialization and use of intercultural knowledge and information exchange patient have the choice between different medicinal systems available for their health care needs. Some remedies may have beneficial properties while others can cause adverse reactions. The emergence of biodiversity plays an important role in globalization. We conclude that ethnopharmacology is the holistic approach to drug research and development by using the latest technologies to discover lead compounds or bioactive substances. Therefore, high standards confirming work on the safety and effectiveness of folk medicine and traditional medicine are needed. Sound scientific data for many commercialized medicines or health products are still lacking. Therefore, a much more multidisciplinary scientific approach is required to local and traditional medicine.

KEYWORDS: Ethnopharmacology, Traditional medicines, Drugs, Globalization.

INTRODUCTION

Ethnopharmacology is an amalgam of perspectives, including Pharmacology, Pharmacognosy, Anthropology, and Botany. Contributions have been made by history of science, practitioners, agronomists, biochemists, and also by researchers of Veterinary Science. The masterly biocultural perspectives on ethnopharmacology offered by medical anthropology underscore that health and healing are culturally constructed and socially negotiated. A key concept for understanding cultural differences in the explanatory model - is a complex narrative that includes the etiology, symptoms recognition, prognosis, and meaning of a particular illness. Knowledge of all this is basic in understanding why people use medicines and how they judge their efficacy. Further, it is important to understand that like illness, healing is not an event but a process. All components at this process and their sequencing and intersections are relevant to ethnopharmacology.^[1]

Ethnopharmacology is a highly varied approach to drug discovery which includes the observations, description,

and experimental investigation of indigenous drugs and their biological activities contributing to the discovery of natural products with biologic activity.^[2] Traditional Medicine also has a wide range of therapeutic effects and its practice varies from country to country and is referred to as CAM (complementary alternative medicine). The population used CAM because of their belief that this type of treatment is natural and without side effect.^[3]

Our country is an ancient heritage of various traditional medicines. Indian Materia Medica has abundant information on medicinal plants and also has information regarding folk traditions and their therapeutic importance.^[4] Traditional medicines are often complex herbal mixtures and multiple compounds are extracted and give a poly-pharmacological approach to drug discovery this approach changes the concept of one disease-one target-one drug.

In history missionaries in different colonies initially used pharmacologically active plants.^[5] Isolation of psilocybin from psychoactive mushrooms was done by Robert

Gordon Wasson (1898-1986).^[6] The Discovery of digitalis, Quinine (First antimalarial), curare, and aspirin are all based on ethnopharmacological principles. Recently the development of Artemisinin into a semi-synthetic antimalarial agent artemether was also the model research of Ethnopharmacology.^[7,8,9]

There are various drugs developed by Ethnopharmacology.

Ergot- Sclerotium of *Claviceps purpurea* was initially used abortifacient in central European as folk medicine. Adam Lousier (1528-1586)^[10] described its application for the first time in 1582. Indeed, ergot did not stand as a labor-inducing agent because of risk of unborn was too higher and therefore now it is used to stop the bleeding after delivery. Finally, the hemostatic principle of ergot was established and named ergometrine in 1935 (Stroll 1935).^[11]

Ginger- (Zinger Officinale Roscoe)- Besides being used as a spice and food item now become a global medicine used against rheumatism, headache, and respiratory and digestive problems because of its potent anti-inflammatory properties (Chevalier 2000, Williamson's 2022).^[12,13] Well-conducted clinical trials on the therapeutic efficacy and effectiveness of ginger in pain and inflammatory conditions are still lacking (Terry et al, 2011).^[14]

Bacopa monnieri Pennell (Scrophulariaceae) is an important ayurvedic medicinal plant its Hindu name Brahmi is used for many health problems, especially mental problems.^[15] Phytochemical analysis with *B. monnieri* started as early as 1931 and is considered to be responsible for micro pharmacological effects. Recent experiment data obtained suggest that *B. monnieri* leaf extract up-regulates the expression of tryptophan and serotonin transporter. *B. monnieri* extract is currently assessing the cognitive performance of subjects and thus to find a correlation with and between inflammation exudative stress and cardiovascular health.^[16]

Turmeric- (*Curcuma longa*) is an important ingredient in Indian and Chinese cuisine and medicine. India is the biggest producer and consumer of turmeric. The active metabolite curcumin is a mixture of three preponderant diferuloylmethane also used as a coloring agent in the food industry labeled as E100. Clinical studies evidenced curcumin's therapeutic relevance in rheumatoid arthritis, psoriasis, inflammatory bowel disease, inflammatory eye disease, and kidney transplantation. By nature, a completely different perspective regarding curcumin use as a food dye has been adopted by European Food Safety Authority (EFSA 2010).^[17]

Semi-synthetic derivatives of Artemisinin, obtained from "Quang Hou" a Chinese medicinal herb (*Artemisia Annua*) are used as the mainstay of treatment of malaria (Kumar and Clark 2021).^[18] Artemisinin is a highly

bioactive pharmacophore (Lactone containing 1,2,4trioxone), Artemisinin besides having anti-plasmodium activity also has an antitumor effect on cancer cells. Its anti-plasmodium activity explains the sensitivity of cancer cells to Artemisinin (Mercer et al 2011).^[19] A Survey conducted on antimalarial use of Artemisinin in Kenya and Uganda revealed that HIV/AIDS patients use this herb. (Willcox et al-2011).^[20] Although identification of the compounds responsible for its anti-HIV effects is still not known. The use of *Annua* in rural areas of Africa for HIV infection highlights the perception of the search for new medical treatment and plays an important role. With the emergence of new diseases, treatments, and limited financial resources, ethnopharmacology may give effective therapies in the modern era (Sewell et al 2006) of medicine.^[21]

Contribution of Ethnopharmacology to Modern Medicine

Natural products or traditional medicine have been the source of active compounds in today's medicine for many years. Till now about half of the drugs approved were based on natural products. From 2005 to 2007 about thirteen natural product-related drugs were approved. About 60% of the anticancer drugs and 75% of Anti-infectious drugs were approved from 1981-2002 and were of natural origins. About 61% of new chemical compounds introduced as the drug could be traced and inspired by the natural product.^[22] There are several examples of important drugs that developed from medicinal plants such as – Atropine, Aspirin, Artemether, Colchicine, digoxin, morphine, quinine, Quinidine, Pilocarpine, Vincristine, Vinblastine, etc. The study of traditional cures and folk knowledge gives new insight into the development of new compound.^[23] Various drug molecules have developed from Ayurvedic experimental *Rauwolfia* alkaloids for Hypertension, psoralens for vitiligo, etc. More than 100 natural compounds have been derived currently and are in the pre-clinical phase of drug development.^[24]

Today's drug discovery and development have become very complex and time-consuming and the pharmaceutical industry is technology-intensive, not innovative because of the shortage of new lead compounds. Strict regulatory norms added many years to complete a drug discovery cycle and increased the cost needed for post-marketing surveillance and withdrawals. Discovery of the new lead compound by using random screening of plants that are used traditionally is expensive and also time-consuming therefore, the use of the ethnopharmacology approach has become very useful in screening and identification of new bioactive compounds and increased the chances of drug discovery of new compound with potential therapeutic use with a reduction in cost and time. There is also increased demand for ethnopharmacology due to the emergence of drug resistance in microorganisms, various side effects of modern drugs, and the emergence of a new disease

with no available treatment modalities therefore knowledge of indigenous people can give new source of drug development and holistic approach supported by the knowledge of ethnopharmacology can serve as an innovative and new discovery source for a new drug that is safer and at affordable cost.

Globalization in traditional medicine

Traditional medicine in India can be classified as codified (Ayurveda, Unani, Siddha, Homeopathy) and non-codified (Folk medicine). Both systems contribute equally to primary healthcare. Now, traditional medicine both codified and non-codified has become a global movement with rapid growth in economics and communication technologies. In many Asian countries, traditional medicine is widely used and accepted over western medicine with the globalization of the media via the internet many medicinal plant species are easily available in the entire market even without correct scientific identification with large safety concerns. In developing countries, uncoded traditional medicine (Folk remedies) is the only accessible and affordable available treatment. The globalization of traditional medicine particularly noncodified pharmacopeia raises many questions like does the use of traditional remedies reflects major health issues in society. Some remedies may have beneficial properties while others can cause adverse reactions. The emergence of biodiversity plays an important role in globalization. To alleviate the loss of the earth's flora and fauna, the **Convention on Biological Diversity** (CBD) was established with the following objectives.

- (1) Conservation of biodiversity.
- (2) Sustainable use of components of biodiversity.
- (3) Equitable sharing of benefits derived from the commercial use of genetic resources.

Medicinal practices in the Indian sub-continent began to intermingle with other countries' medicine from the 12th century onward. Towards the end of the eighteenth century, the British began to introduce the western system of medicine (Srivastava 1954).^[25] This historical movement led to the current situation. With the global commercialization and use of intercultural knowledge and information exchange patient have the choice between different medicinal systems available for their health care needs with the help of physicians specialized in different medical field.^[26] With the globalization and economic development of our country a nation's traditional system of medicine is complemented with "Biomedicine". Alongside biomedicine different traditional systems of medicine and other alternatives (Complementary medicine) are established. Therefore, it is a matter of debate how alternative therapies should be in National Health Services and what is a fair price for individual therapies and health care in general. Khan2006.^[27] specifies that concerning India, western culture and medicine over indigenous science consolidated the drug development. Local health care and medicine are subjected to global commercialization

which directly influences a person's therapeutic choice (Miles 1998).^[27]

Ethnopharmacology – A new hope in drug discovery

Recent commercial endeavors by the nutraceutical industry start a trend toward formulations adopting the concept of Poly-pharmacology or network pharmacology instead of the concept of one lock (target) and one key (drug) and not a single disconnected drug target. The medicinal plant has not been designed to cure human diseases or alleviate their symptoms with undesired and antagonistic effects. The strategy of poly-pharmacology is too old as medicine itself and the food supplement industry provides several phytochemicals or bioactive molecules. One should however keep in mind that a variegated and balanced diet not only lasts better than pills and capsules but is also healthier.

Natural product drug discovery and Ethnopharmacology emerge as a new hope in the current target-rich, poor, lead compound scenario.^[28] Industrial drug discovery makes use of high throughput bioassays for the discovery of a particular target but in ethnopharmacology, anecdotal efficacy of medicinal plants is put in laboratory testing to understand the pharmacological basis of important cultural plants. Active profiling of plant extracts and biological-oriented synthesis are the approaches toward the value of natural products. New technology for measuring gene expression metabolome and proteome is available to help better understand the mode of action of a new product by comparing the changes in the transcriptome, and proteome pattern. Such a type of approach is known as the System Biology approach.^[29,30] Currently, the methods that are used in metabolomics (quantitative analysis of all metabolites present in an organism) are

- (1) Chromatography-based methods (HPLC, GC)
- (2) Mass spectrometry (Molecular weight-based methods)
- (3) Physical characteristics-based methods (NMR Spectrometry)

Hurdle in ethnopharmacology (Barriers and Challenges)

Traditional medicine (Folk medicine) will only be accepted by the primary health care system when experimental, clinical data, and evidence have been established (Cordell 2011).^[31] Therefore, high standard studies confirming the safety and effectiveness are required. Very few scientific researches are conducted on these products due to a lack of communication among traditional traders, treating doctors, and scientists. This communication gap can be filled by translating the old concepts into modern medicine.

Another problem is the large competition in drug research and development among pharmaceutical industries. Carelessly carried out bioassays of an extract or natural plant product to demonstrate their pharmacological response. Sufficient quality control and

drug standardization are needed for traditional medicines.

Pharmaceutical biopiracy is also a big issue exploiting the indigenous people's traditional knowledge of medicine.

According to WHO, the most important challenges in Ethnopharmacology are

- (1) Research into safe and effective traditional medicine. Alternative medicine for diseases that represent the greatest burden among the poor population.
- (2) Recognition of the role of Traditional medicine practitioners.
- (3) Upgrade skills of Traditional medicine.
- (4) Protection and presentation of the knowledge of indigenous drugs.
- (5) Sustainable cultivation of medicinal plants.
- (6) Reliable information on the proper use of Traditional medicines.

In INDIA, problems related to Ethnopharmacology are

- (1) Lack of national policies.
- (2) Absence of policies that include medicinal plants.
- (3) Ignorance of the benefits of the Phyto pharmaceutical industry.
- (4) Limited resources.
- (5) Lack of technical knowledge for the production of herbal products.
- (6) Absence of conservation policies for the cultivation of herbs under best conditions. (7) Lack of legal parameters for commercialization of herbal products.
- (7) Limited research in, ethnopharmacology, agrotechnology pharmacy, and therapeutic validation.

CONCLUSION

We conclude that ethnopharmacology is the holistic approach to drug research and development by using the latest technologies to discover lead compounds or bioactive substances. Ethnobotanists, ethnopharmacologists, Phyto chemists, and physicians have to work together. Ongoing globalization by neoliberalism, medical plurality through intercultural knowledge, and advanced information technologies give new insight into ethnopharmacology.

Knowledge transmission, local availability of biomedicine easy access to research data on traditional and herbal medicine may lead to syncretic development since traditional medicine will only be accepted by the primary health care system where evidence of experimental and clinical data is established. Therefore, high standards confirming work on the safety and effectiveness of folk medicine and traditional medicine are needed. Sound scientific data for many commercialized medicines or health products are still

lacking. Therefore, a much more multidisciplinary scientific approach is required to local and traditional medicine.

REFERENCES

1. Elisabetsky E, Etkin LN. Ethnopharmacology-vol-1- Ethnopharmacology: An overview, 2009.
2. The Value of Plants Used in Traditional Medicine for Drug Discovery Documents [Internet], 2015; 9. Available from: <http://documents.inx/documents/the-value-of-plants-used-in-traditional-medicine-for-drug-discovery.html>.
3. WHO Traditional Medicine: Definitions. World Health Organization, 2015; 9. Available from: <http://www.who.int/medicines/area/traditional/definitions/>.
4. Mukherjee PK. Venkatesh P. Ponnu Sankar Ethnopharmacology and integrative medicine - Let the history tell the future. J Ayurveda Integer Med, 2010; 1(2): 100-9.
5. Gertsch J. How scientific is the science in ethnopharmacology? Historical perspective and epistemological problems. J Ethnopharmacol, 2009; 122(2): 177-83.
6. Wasson, V. P, and Wasson, R. G. and Mushrooms Russia and History, VIL New York: Pantheon Books. Weckerie, C. S., Cabras, S., Castell, mos, M. E., and Lonti, M. (2011). Quantitative methods in ethnobotany and ethnopharmacology: considering the overall flora-hypothesis testing for over-and underused plant families with the: Bayesian approach. J Ethnopharmacol, 1957; 137, 837-843. DOI: Prac 10.1016/j.2011.
7. Anagnostou S. Jesuits in Spanish America: contributions to the exploration of the American Materia medica. Pharm Hist, 2005; 47: 3-17.
8. Cunningham F. Menezes FS. Ethnopharmacology in Dublin: surveys on the medicinal plants use profile, 2011; 21(5): 814-7.
9. Harvey A. Natural products in drug discovery. The drug, Discovery Today, 2003; 13(19-20): 894-901.
10. Adams, M., Gschwind, S., Zim mermann, S., Kaiser, M, and A Hamburger, M. Renais sance remedies: antiplasmodial protostane triterpenoids from Alisma plantero-Aquatica L. (Alismataceae). J. Ethnopharmacol, 2011b; 135: 43-47. DOI: A 10.1016/j.jep.2011.02.026
11. Stoll, A. The new ergot alkaloid. Science, 1935; 82: 415-417. DOI: 10.1126/ 10.10 016 schmoe.82.2131.415
12. Chevallier, A. Encyclopedia of Herbal Medicine. The Definitive Reference to 550 Herbs and Remedies for Common Ailments. New York: DK Publishing, 2000.
13. Williamson, E. Major Herbs of Ayurveda London: Churchill Living stone, 2002.
14. Terry, R., Posadzki, P., Watson, L K, and Emst, E. The use of ginger (Zingiber officinale) for pain treatment: a systematic review of a clinical trial.

- Pain Med, 2011; 12: 1808-1818. DOI 10.1111/1526-4637.2011.01261.x
15. Russo A, Borrelli F Bacopa monniera, a reputed nootropic plant: an overview. *Phytomedicine*, 2005; 12: 305–317. doi: 10.1016/j.phymed.2003.12.008.
 16. Stough, C. K., Past, M. P., Crop- ley, V. Myers, S., Notidin, K, King R, et al A randomized controlled trial investigating the effect of Pycnogenol and Bacopa CDRI08 herbed medicines on cognitive, cardiovascular, and biochemical functioning in cognitively healthy elderly people the Australian Research Council Longevity Intervention (ARCLI) study protocol (ANZCTRI2611000457910). *Nutr. J. medicines. Dic*, 2012; 11: 11. DOI: 10.1186/1-175-2891-11-11
 17. Goel, A., Kannuurnakkara, A. B., and Aggarwal, B. B. CERCIERED as "Curcumin": from the kitchen to clinic. *Biochem. Pharmacol*, 2008; 75: 787-809. F DOI: 10.1016/j.bcp.2007.08.016
 18. Kumar, P., and Clark, M. *Clinical Medicine*, 4th Edn. London: W. B. Saunders, 2001; 1.
 19. A. E, Copple, I. M., Mags, a) L, O'Neill, P. M., and Park, B. J. K. The role of heme and the mitochondrion in the chemical and molecular mechanisms of mammalian cell death induced by the artemisinin antimalarials. *J. Biol Chem*, 2011; 286: 987-996. DOI: eria 10.1074/jbc.M110.144188.
 20. Willcox, M. L, Burton, S., Ojweka, R, Namyalo, R., Challand, S, and Lindsey, K Evaluation and pharmacovigilance of project: promoting cultivation and local use of Artemisia & me for malaria. *Malar. J*, 2011; 10: 84. DOI: 10.1186/1475-287 5-10-84.
 21. Sewell, R. A., Halpern, J. H., and Pope, H. G. J. Response of duster headache to psilocybin and 1SD. *Neurology*, 2006; 66: 1920-1922. DOI: 10.1212/01.Wnl0000219761.05466.43.
 22. Gupta R, Gabrielsen B, Ferguson 3M. Nature's medicines: traditional knowledge and intellectual property management. Case studies from the National Institutes of (21) Health (NIH), USA. *Curr Drug Discov Techno [Internet]*, 2005; 2(4): 203–19.
 23. Gilani AH, Atta-ur-Rahman. Trends in ethnopharmacology. *J Ethnopharmacol*, 2005; 100(1-2): 439.
 24. Patwardhan B. Ayurveda: The "Designer" medicine: A review of ethnopharmacology and bioprospecting research. *Indian Drugs*, 2000; 37(2000): 213-27.
 25. Srivastava, G. P. *Development of Indian Pharmacy*, Calcutta: Pindars Limited, 1954; 2: 1.
 26. Khan, S. Systems of medicine and nationalist discourse in India Towards "new horizons" in medical anthropology and history. *Soc. Sci. Med*, 2006; 62: 2786-2797. DOI: 10.1016/j.socscianed.2005.10. 039
 27. Miles, A. Science nature, and tradition: the mass-marketing of natural- medicines in urban Ecuador. *Med Anthropol Quart*, 1998; 12: 206-225. DOI: 10.1525/ mag.1998.12.2.206
 28. Patwardhan B. Ethnopharmacology and drug discovery. *J Ethnopharmacol*, 2005; 100(1-2): 50-2.
 29. HolmesHolmes, E., Nicholls, A.W., Lindon, J.C., Connor, S.C., Connelly, J.C., Haselden, J.N., Damment, S.J.P., Spraul, M., Neidig, P., Nicholson JK. Chemometric models for toxicity classification based on NMR spectra of biofluids. *Chem Res Toxicol*, 2000; 13: 471-8.
 30. Verpoorte R, Choi YH, Kim HK. Ethnopharmacology and systems biology. A perfect holistic match *J Ethnopharmacol*, 2005; 100(1-2): 53-6.
 31. Cordell, G. A. Sustainable medicines and global health care, 2011.