From the Field into the Lab: Contribution of Traditional Knowledge to Modern Medicine

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ABSTRACT

The contribution of traditional knowledge to modern medicine has been recognized as it provides valuable clues to the scientific community for drug discovery. Although western science was reluctant to recognize its contribution until recently, there is growing interest in traditional knowledge in recent years. There are well-established cases of traditional knowledge from around the world that have led to drug discovery. There is also a huge potential to explore this area in Nepal. In this short communication, we discussed some examples of traditional knowledge that are the source of clues for drug discovery, and also discussed the prospects of traditional knowledge and bioprospecting in Nepal. We hope that this brief article is of interest to readers outside the traditional knowledge and biodiversity domain.

Keywords: Biodiversity; Drug discovery; Ethnobotany; Nepal; Plants.

BACKGROUND

Fossil records have traced back the human use of plants as medicines to at least 60,000 years.[1] It can be imagined that the use of natural products as medicines must have presented a tremendous challenge to early humans. It was quite possible that when seeking food, early humans often consumed poisonous plants, which led to vomiting, diarrhea, or other toxic reactions that probably caused the death of many people.[2] Nevertheless, these were the only options left for early humans who were subsequently able to develop knowledge about edible materials and natural medicines.[3] Subsequently, humans invented fire, learned how to make alcohol, developed religions, made technological breakthroughs, and they learned how to cope with diseases, and finally developed new drugs.[2]

In this way, since prehistoric times, millions of people rely on medicinal plants for primary health care.[4] Such traditional medicine is intimately connected with the traditional knowledge of indigenous peoples and local communities. The interest in traditional knowledge has been renewed as many traditional herbal practices have led to the discovery of the drugs. The scientific discipline that studies the use of plants by indigenous peoples and local communities is termed “ethnobotany”.

Drugs discovered from ethnobotanical leads

The ethnobotanical approach is actually one of several methods that can be applied in choosing plants for pharmacological studies.[4] In fact, it provides rapid clues to the scientist for selecting the candidate species for further studies (Table 1). To cite some examples, medications such as aspirin, codeine, ipecac, reserpine, etc. are the drugs discovered from ethnobotanical leads.[4,5] The credit goes to Paul Alan Cox and Michael L. J. Balick who explored and emphasized the contribution of traditional knowledge to modern drug discovery in the early 1990s (see Cox and Balick[5]). The discovery of quinine is considered the most remarkable medical discovery of the 17th century.[7] Quinine, a component of the bark of the cinchona (*Cinchona pubescens*) tree, was used to treat malaria

Table 1: Drugs discovered from ethnobotanical leads

Drug	Medical use	Plant source
Aspirin	Reduces pain and inflammation	*Filipendula ulmaria*
Codeine	Eases pain; suppresses coughing	*Papaver somniferum*
Ipecac	Induces vomiting	*Psychotria ipecacuanha*
Pilocarpine	Reduces pressure in the eye	*Pilocarpus jaborandi*
Pseudoephedrine	Reduces nasal congestion	*Ephedra sinica*
Quinine	Combats malaria	*Cinchona pubescens*
Reserpine	Lowers blood pressure	*Rauvolfia serpentina*
Scopolamine	Eases motion sickness	*Datura stramonium*
Theophylline	Opens bronchial passages	*Camellia sinensis*
Vinblastine	Combats Hodgkin's disease	*Catharanthus roseus*

Source: Cox and Balick.[5]

from as early as the 1600s. The tree grows widely in Andes countries such as Peru, Bolivia, and Ecuador. The legend of quinine's discovery accepted in Europe however differs from that of reality. In fact, the plant was used to treat high fever by the native population in these Andes countries which was minutely observed by the European missionaries. With this clue from the native people, the European were successful to extract the quinine. In this particular case, the European were reluctant to acknowledge the knowledge of the native people. The discovery of another antimalarial drug called artemisinin has also its root in indigenous use. Artemisinin was discovered from the *Artemisia annua*, and the use of this plant in China in treating fevers dates back at least two millennia.[8] There was good documentation of this information in Traditional Chinese Pharmacopeia. In both cases, the important information was derived from the traditional knowledge that ultimately facilitated and led to drug discovery. These examples well illustrate the importance of scientific documentation of traditional knowledge. As natural-product research continues, despite emerging new chemical, biotechnological, and screening technologies, to be absolutely essential for the industry the traditional knowledge is still highly relevant.[9]

Medicinal plants in Nepal

Ethnobotanical approaches to research have revealed about 2,000 medicinal plants in Nepal.[10] These plants are distributed widely across Nepal but surprisingly the lowlands are found to be particularly rich in medicinal plants richness.[11] Nepali botanist community including students has contributed a lot to documenting the wealth of knowledge regarding medicinal plants in Nepal. Around 275 pieces of scientific literature exist for Nepal that deal with ethnomedicinal uses practiced in Nepal.[10] Candidate species for phytochemical screening and pharmacological investigation are also revealed through such ethnobotanical approaches.[12,13] Researchers from botanical, biotechnological, and chemical sciences in academia, government, and private sectors are also working on phytochemical screening (Figure 1). Despite of this attempt, successful case studies of drug discovery are yet to be established.[14] More scientific research is needed to determine the active principles of traditional medicinal recipes and to evaluate their effectiveness so that benefits could be equally shared among local peoples in the spirit of the Convention on Biological Diversity and Nagoya Protocol.[15] Ethical considerations are important in such research but these are inadequately practiced in Nepal.

Bioprospecting research on medicinal plants

Bioprospecting is a systematic search of biologically active natural molecules, useful genetic information, and biological design which can be commercialized in the form of commercial products. Bioprospecting can be conducted with two approaches: a random approach and traditional knowledge (TK) based approach. In the first approach, all the available biodiversity samples are subjected to a bioprospecting process. This approach needs a larger volume of work, longer time, and huge resources. Conversely, the second approach, i.e., the TK-based approach gives important clues for selecting biodiversity resources for the specific bioprospecting process. It helps to reduce the work volume, required time, and resources for bioprospecting. However, bioprospecting needs modern technology, well-equipped research infrastructures, and trained human resources. Novel research results of the bioprospecting can be patented, published, and commercialized depending on their potential values. Bioprospecting is a subject of long-term investment which can support the nation with various innovative findings. In the case of Nepal, though we have a potential source of biodiversity, the pace of bioprospecting is not satisfactorily advanced. For this, the Access and Benefit Sharing Strategy and Action Plan and National Bioprospecting Strategy and Action Plan should be formulated so that they create a conducive environment fostering collaborative research. In addition, the universities and national research institutions must be empowered to carry out bioprospecting research projects.

Need for collaboration

One of the possible reasons for not being successful in leading to drug discovery in Nepal is the lack of well-equipped laboratories and inadequate trained human

resources. The possible way for this is to make collaboration with technology-rich countries. Such countries which are rich in technology but poor in biodiversity and associated traditional knowledge would collaborate with Nepali scientific communities when they are invited to so do with the formulation of proper policy frameworks as stated above. In this way, the government could play a crucial role in promoting research on biodiversity and bioprospecting.

CONCLUSION

The successful cases that have led traditional knowledge to drug discovery show that such knowledge is a valuable asset for modern medicine. There is also a high potential for using the traditional knowledge for bioprospecting in Nepal to develop natural and effective commercial products of medicinal, cosmetic, and nutritional value. Currently, the pace is rather slow but the conducive environment of the government and collaboration with technology-rich countries could lead to successful cases. Therefore, the importance of biodiversity, traditional knowledge, and bioprospecting should be recognized and must be given high priority in the national R&D agenda.

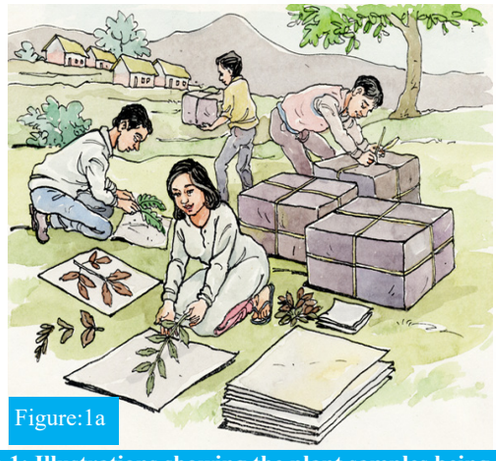

Figure:1a

Figure:1b (Source: IUCN Nepal)

Figure 1: Illustrations showing the plant samples being taken from the field (Figure 1a) and the laboratory work (Figure 1b)

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