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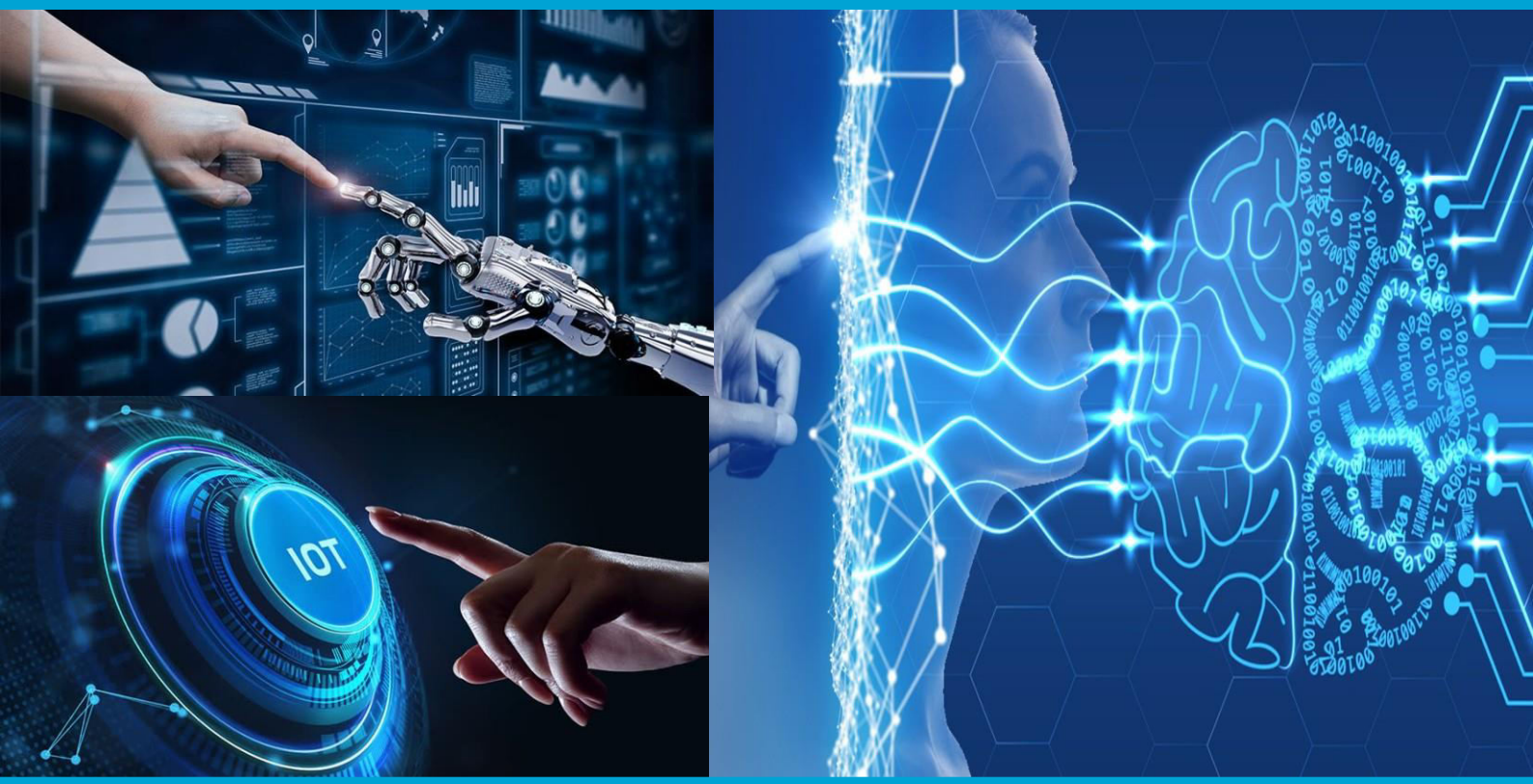

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Ethnobotany Genomics: Discovery and Innovation in a New Era of Research

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ABSTRACT: We present here the first use of DNA barcoding in a new approach to ethnobotany we coined "ethnobotany genomics". This new approach is founded on the concept of 'assemblage' of biodiversity knowledge, which includes a coming together of different ways of knowing and valorizing species variation in a novel approach seeking to add value to both traditional knowledge (TK) and scientific knowledge (SK). We employed contemporary genomic technology, DNA barcoding, as an important tool for identifying cryptic species, which were already recognized ethnotaxa using the TK classification systems of local cultures in the Velliangiri Hills of India. This research is based on several case studies in our lab, which define an approach to that is poised to evolve quickly with the advent of new ideas and technology. Our results show that DNA barcoding validated several new cryptic plant species to science that were previously recognized by TK classifications of the Irulas and Malasars, and were lumped using SK classification. The contribution of the local aboriginal knowledge concerning plant diversity and utility in India is considerable; our study presents new ethnomedicine to science. Ethnobotany genomics can also be used to determine the distribution of rare species and their ecological requirements, including traditional ecological knowledge so that conservation strategies can be implemented. This is aligned with the Convention on Biological Diversity that was signed by over 150 nations, and thus the world's complex array of human-natural-technological relationships has effectively been re-organized.

KEYWORDS: ethnobotany, genomics, new era, innovation, research, India, DNA barcoding, ethnotaxa

I. INTRODUCTION

The present study is an attempt to analyze the world publication of ethnobotany genomics by using “DNA barcoding” and “DNA barcoding plants” as keywords. Some of the parameters used for the analysis include the publication output, countries’ performance, the institutions involved, subject areas, authors, and journals distribution. The Scopus International Database is used for this purpose. An evaluating indicator, citations and h-index are applied to characterize the ethnobotany genomic publication output. It is interesting to note that over the past decade, there has been a notable growth in publication output. Moreover, there has been a significant increase in the participation from a number of countries as well as institutions, subject categories, journals, authors, and collaborations.[1,2] The increasing significance of ethnobotany genomics was analyzed by ranking countries, institutions, subject categories, journals, authors and collaborations in terms the total number of publication, their citations and h-index. In recent times, ethnobotanical (the aim of ethnobotany is to study how and why people use and conceptualize plants in their local environments. The discipline addresses how and in what ways people use and view nature. As a field of research and study, ethnobotany is an interdisciplinary, holistic approach that includes botany, anthropology, history, chemistry etc.) Research has gained a vital role for the discovery of new drugs and new drug development. The present study is an attempt to analyze the world publication of ethnobotany genomics by using “DNA barcoding” and “DNA barcoding plants” as keywords. Some of the parameters used for the analysis include the publication output, countries’ performance, the institutions involved, subject areas, authors, and journals distribution.[3,4] The Scopus International Database is used for this purpose. An evaluating indicator, citations and h-index are applied to characterize the ethnobotany genomic publication output. It is interesting to note that over the past decade, there has been a notable growth in publication output. Moreover, there has been a significant increase in the participation from a number of countries as well as institutions, subject categories, journals, authors, and collaborations. The increasing significance of ethnobotany genomics was analyzed by ranking countries, institutions, subject categories, journals, authors and collaborations in terms the total number of publication, their citations and h-index. Therefore, modern technology like genomics (the term “genomics” was coined by mouse geneticist Tom Roderick to describe an approach to the study of DNA at the level of chromosomes, entire genomes, or large clusters of genes)[5,6] has emerged as a vital tool for the researchers engaged in biodiversity, and who deal with the inventory and management of earth’s immense and changing biodiversity. Identification at the species level is required for quality assurance, which includes both identifying the crude plant product and evaluating its pharmaceutical quality. Today, DNA barcoding (genomics) has principally emerged as an area that provides a forum for the exchange of information in the fields of biological studies.

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It serves as a rapid and cost-effective method for the identification of biodiversity, and is revolutionizing the application of taxonomy for taxa with validated data sets.[7,8]

II. REVIEW OF LITERATURE

The leaf homogenate of *Psychotria insularum* is widely used in Samoan traditional medicine to treat inflammation associated with fever, body aches, swellings, wounds, elephantiasis, incontinence, skin infections, vomiting, respiratory infections, and abdominal distress. However, the bioactive components and underlying mechanisms of action are unknown. We used chemical genomic analyses in the model organism *Saccharomyces cerevisiae* (baker's yeast) to identify and characterize an iron homeostasis mechanism of action in the traditional medicine as an unfractionated entity to emulate its traditional use. Bioactivity-guided fractionation of the homogenate identified two flavonol glycosides, rutin and nicotiflorin, each binding iron in an ion-dependent molecular networking metabolomics analysis. Translating results to mammalian immune cells and traditional application, the iron chelator activity of the *P. insularum* homogenate or rutin decreased proinflammatory and enhanced anti-inflammatory cytokine responses in immune cells. Together, the synergistic power of combining traditional knowledge with chemical genomics, metabolomics, and bioassay-guided fractionation provided molecular insight into a relatively understudied Samoan traditional medicine and developed methodology to advance ethnobotany.[9,10]

The ethnobotany genomics concept is founded on the idea of 'assemblage' of biodiversity knowledge. This includes a coming together of different ways of knowing and valorizing species variation in a novel approach seeking to add value to both traditional knowledge (TK) and scientific knowledge (SK). Ethnobotany genomics is defined as exploring the variation in genomic sequences from many species, and here we present some of our recent work that demonstrates the potential benefits of this approach for ethnobotanical research with economic implications. DNA barcoding was used to identify Acacia and nutmeg taxa that are economically important to society-at-large. Furthermore we identified considerable variation that is recognized by several indigenous cultures. The impacts of ethnobotany genomics will extend well beyond biodiversity science. Explorations of the genomic properties across the expanse of life are now possible using DNA barcoding to assemble sequence information for a standard portion of the genome from large assemblages of species. Perhaps the most important contribution is major barcode projects will leave an important legacy; a comprehensive repository of highquality DNA extracts that will facilitate future genomic investigations.[11,12]

III. MATERIALS AND METHODS

New perspectives have opened with the emergence of new molecular tools, especially for DNA sequencing, allowing phylogenetic reconstruction with hot nodes clustering potentially useful plants, including species traditionally used for medicinal purposes. The use of the same (or closely related) species in the same ways in different cultures indicates that different and often non-interacting human groups have independently acquired this knowledge, because some plants have similar morphological characteristics from a shared phylogeny, a phenomenon termed evolutionary convergence. In this case, we propose to speak of plant-use convergence or ethnobotanical convergence for the similar uses for plants included in one node of a phylogeny. Determining the phylogenetic relationships amongst plant species could be an appropriate tool for discovering new drugs based on recorded plant medicinal uses and analysing ethnobotanical data. Plants evolving in the same lineage have more medicinal uses than evolutionarily isolated species, and the diversity of medicinal uses is correlated with the evolutionary history of the species. Species-rich clades are more likely than species-poor clades to contain taxa with more uses, and ancient taxa are less abundant in the flora, so less used in traditional medicine[13,14]

IV. DISCUSSION

Ethnobotany is a scientific discipline that comprises the study of human interaction with plants. It mainly focuses on the study of a region's plants along with the practical knowledge of those plants with the help of the traditional knowledge of local people and their culture. It is a branch of botany which dates to ancient times. The term ethnobotany was coined by John William Harshberger in 1895, to describe the study of plants used by local people belonging to a particular area. Ethnobotany can be defined as the systematic study of the relationship between people and plants. Ethnobotany can be defined as the study of the relationship between plants and the people of a particular society. Or, we can say that ethnobotany is the study of the contextualised use of plants.

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- The importance of ethnobotany is manifold
- Ethnobotany provides knowledge on the traditional uses of plants; this knowledge can be used towards the development of societies
- The study of ethnobotany tells us about unknown but useful plants and also helps in understanding the new uses of many plants that are already known to us
- Ethnobotany is essential for tribal groups of people
- Tribal people mostly depend on forest products for their daily needs and primary health care[15,16]
- Tribal people collect food oils, medicines, gums, dyes and tannins from the forests, and these groups of people in the Northeast region of India depend on the forest and its products for their basic needs, even today
- Many tribes practise shifting cultivation, which is also known locally as "jhum cultivation". In this type of cultivation, a patch of land is cleared, crops are grown on that land, and when the soil loses its fertility after growing one or two crops, the people leave the land, move towards other parts of the forest, and continue this process
- Medicinal plants also provide a source of drugs for the majority of the global population today. This is referred to as medico-ethno botany. This aspect also shows us the importance of ethnobotany
- During the last few decades, some drugs such as quinine, cocaine, digoxin, and taxol have been discovered from plants, due to the knowledge of ethnobotany
- Some of the bioactive compounds such as artemisinin, gossypol, hypericin, etc. have also been recently discovered due to the understanding of the relationship between plants and society
- Ethnobotany also encourages awareness for establishing a link between biodiversity and cultural diversity as well as the mutual influence of plants and humans
- Therefore it is necessary for people in our country to understand the different aspects of ethnobotany[17,18]

V. RESULTS

- Plant resources have always served the primary needs of humans (including healthcare) since time immemorial. Indigenous knowledge of plants is recognised worldwide owing to their intrinsic value, as well as in the field of modern drug development
- Plants are used as traditional herbal medicines in many parts of India by local ethnic people, especially in the Himalayan region
- In fact, all traditional systems of medicine in India and around the world have their roots and origin in ethnomedicines
- Due to the lack of research support, educational opportunities and understanding the dialects of tribal people, India is still unable to fully recognise the importance of ethnobotany
- The study of ethnobotany helps in relaying information to administrators and scientists to prepare action plans for the economic growth and development of tribal areas
- Ethnobotany plays a significant role in understanding natural resources, which provide raw materials for agroforestry
- Some crops are cultivated for generations and hence, they represent a distinct genetic stock adapted to local conditions. An example of this is the Moghania vestita which is a tuber crop of Khasi and Jaintia Hills
- In India, various plants are included in nature-worship traditions. Some areas of forest are called sacred groves which play an important role in environmental conservation. Many sacred groves are seen in various parts of Meghalaya and Sikkim. In Meghalaya, these sacred groves are locally known as Lawkyntang and in Sikkim, they are known to the locals as Lungchuk[19,20]

VI. CONCLUSIONS

Ethnobotany studies the relationship between plants and the people of various societies; an important relationship for many tribal groups. Forest products provide tribal people with the materials they need for their daily living, including material required for their physical and health-related needs.

Traditional systems of medicine in India, and around the world, originate from ethnomedicines. Conducting research into the relationship between plants and societies may help us in related areas such as drug discovery and environmental conservation.[20]

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