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A Review On Ethnobotanical Genomics: Nexus of Traditional and Scientific Knowledge

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Abstract

Plant-derived natural products (NPs) have been fundamental to traditional medicines, providing essential therapeutic compounds. Indigenous knowledge has taken precedence in this era, and ethnobotany has developed into a science of survival. A number of new plant molecules, including those used by hundreds of cultures, have been described, and medicinal plants are still being sold for their therapeutic benefits without the necessary identification and validation. The review investigates the evolution and current level of traditional plant knowledge among ethnic groups, as well as the incorporation of modern trends into ethnobotanical studies. Molecular analysis (Scientific knowledge) for identifying Ethnotaxa, and the application of DNA barcoding, for authentication of plant species identified using traditional knowledge. Linking scientific and traditional categorization systems, which are often unwritten and only passed down orally, is crucial.

Keywords: Ethnic communities**,** Ethnobotany, DNA Barcoding, Multidisciplinary, Scientific Knowledge, Traditional knowledge

INTRODUCTION

From the beginning of civilization, people have relied on plant diversity as a source of food and other essentials. The primary reasons for man's interest in plants must have been for food and shelter, followed by protection, which subsequently evolved into the search for cures for illnesses and wounds(Rahmann and Afzal, 2019) According to estimates from the World Health Organisation (WHO), notably those in developing and undeveloped countries, more than 75%

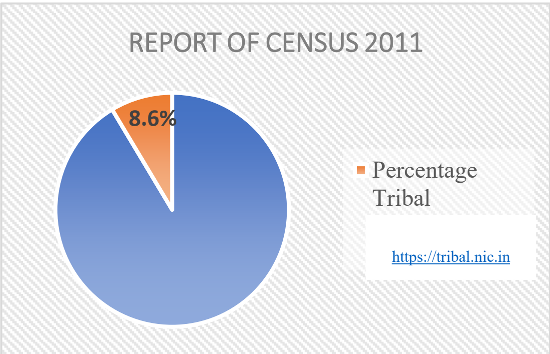
of the world's population relies on plant-derived medicines received from traditional healers (Garaniya and Bapodra 2014). Even though modern facilities are available, many of these communities still rely on traditional treatment and undeveloped pharmaceuticals (Wagh, 2016). Traditional knowledge of Plants from Traditional healers of ethnic communities is generally about field work, the collection of herbs, maintaining Herbarium and gathering information about the medicinal properties of a particular plant species as well as crude drugs obtained or different ways preparing medicine Traditionally. In order to research and explore Ethnobotany from New dimension, researchers from all around the world are striving to use statistical, quantitative, ecological, pharmacological and molecular methodologies along with qualitative assessment of the flora. DNA barcoding is an emerging molecular identification, authentication, and categorization technology that has been used on medicinal plants since 2008 (Yu et. al., 2021).

REVIEW METHODOLOGY

This review covers a literature search and the selection of pertinent publications. The literature was gathered by searching the major electronic scientific databases, such as PubMed, Science Direct, Web of Science, Google Scholar, and Several Publish Books, with appropriate keywords such as ethnobotany, tribes, ITK, TEK, scientific knowledge, Genomics, DNA Barcoding, This study exclusively used previously published works. (Nigussie et. al., 2022)

Ethnic Communities And Ethnobotany

Tribes / Ethnic communities/Indigenous groups are social groups that may include subdivisions like sibs or villages but also share a common progenitor and governing deities. Their identity and dialect are distinctive (Dwivedi et. al., 2022). Article 342 of the Indian Constitution states that there are 730 district tribes (ethnic communities) in India, accounting for 8.6% of the country's total population (Govt. Of India, 2009).



The biggest concentration of tribal people is found in central India (Beniwal, 2021). There are over 5000 indigenous communities recognized worldwide. India is one of the centres of ethnobotanical research due to its diversity of vegetation and multiethnic population.

The term "ethnobotany" was first used in 1895 by American botanist Dr. John William Hershberger during a presentation in Philadelphia to describe his research on plants and their connections with aboriginal and primitive people. Ethnobotany also known as Folk botany is indigenous traditional knowledge that is typically unwritten and unpublished and is passed down from generation to generation like a legacy (Jain and Mudgal, 1999).

According to the All India Coordinated Research Project on Ethnobiology, over 9,500 different species of wild plants are used by 550 Indian tribes. There are roughly 8000 wild species that are used for medicine, 3000 species for food, 525 species for fibre and cordage, 330 species for pesticides and piscicides, 300 species for gums, resins, and dyes, and about 100 species for incense and perfumes (Pushpgandhan et. al., 2018). In every location, there exist ethnic communities with their unique knowledge of medicinal plants and other purposes, according to surveys done by researchers in several states and their forests. India is regarded as a significant stockpile of ethnobotanical richness. According to numerous studies, tribal populations in distant areas not only depend on plant-based resources for food, medicine, and forage but also play a crucial role in the management of natural resources (Vijayakumar, 2015). From India's central and northeastern states, the majority of the tribes' ethnic communities are reported. The rich diversity of the north-eastern region is evident in the 13 recognize disciplines of ethnobotany, which include birth control, fish stupefying, brewing, pest management, religious and paranormal belief, season indicators, traditional conservation practices, herbal dyes, weaving, fodder, and wild food. Without adequate validation, ethnobotanical significant plants are included after observation of the area (Mao and Roy, 2016). Documenting indigenous knowledge and assessing how plants from central Indian region are used for a range of reasons became more important in order to preserve it and make it accessible in the future. Scientists are currently cataloguing a variety of plant-based enthnoveterinary practices. For the treatment of more than 36 ailments, around 41 plant species from 39 genera were traditionally employed, along with other plant parts and their mixtures (Verma, 2014). In the Amarkantak hills of the Achanakmar-Amarkantak Biosphere Reserve, the Gonds, Baigas, Bhils, and other ethnic communities have a wealth of traditional knowledge and expertise in the use of phototherapy as health practitioners.

Quantitative indices such as use value, family use value, relative importance, fidelity level, and informant consensus factor were used to collect and analyze the data. These bases led to the designation of 173 species across 148 genera as being either extremely important or widely used.(Lal et. al., 2023). The paliyar traditional healers in southern part of country in Grizzled Squirrel Wildlife Sanctuary (GSWS) identified 239 plants from 190 taxa as regularly utilised ethnomedicine for treating a variety of illnesses (Tresina et. al., 2023). According to ethnobotanical research conducted in Pilibhit Tiger Reserve over 50 health issues have been treated using 45 plant species from 30 families. To stop the spread of malignant tumours and human cancers, 20 crude medications were made from plants such as *Catharanthus, Mirabilis, Achyranthes, Datura, and Ipomea*, which are utilised by tribal and rural populations (Dixit and Vakshasya, 2020, 2021). About 23 plant species from 16 families were reported for the treatment of malarial fever from studies conducted in terai Forest. The work is based on surveys and interviews ,validation and authentication of the species should also be done using modern techniques such as DNA Barcoding. The work that has so far been reported from various regions of the country is largely qualitative.

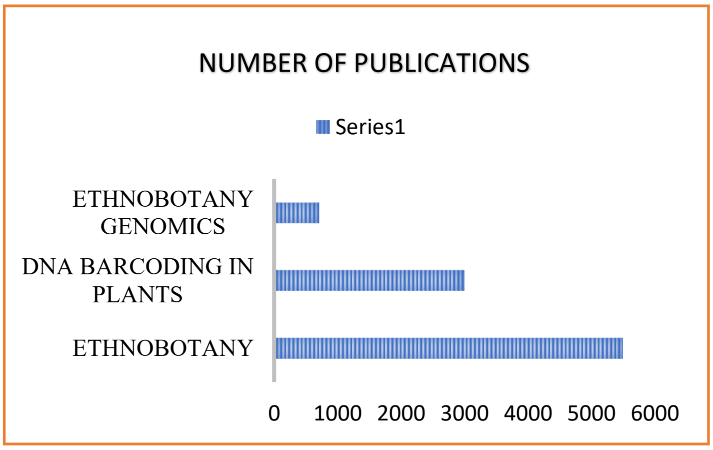
Ethnobotanical genomics

In the discipline of ethnobotany, ethnobotanical genomics is a new area of study (Newmaster and Raghupathy, 2010). In order to examine the relationship between scientific and indigenous systems of botanical classification, this could bring together traditional aboriginal knowledge and scientific information. (Raghupathy et. al., 2009).

Over 50,000 medicinal plants are said to be utilised worldwide to treat a variety of diseases. Additionally, qualitative ethnobotanical knowledge has been documented from all across the globe. Due to the lack of available medications and the increased demand for therapeutic plants caused by the SARS-CoV-2 virus, indigenous knowledge took precedence and ethnobotany evolved into a science of survival (Ina Vandebrock et. al., 2020). Despite the fact that thousands of new molecules have been described from plants, including plants used by hundreds of cultures, medicinal plants are still being marketed for their therapeutic properties without proper validation and identification. The fundamental reason could be disconnect between ethnobotanical field research and Laboratory researchers (McClatchey et. al., 2009). Rarely ethnobotanically important plants are examined for sister species. Since the development of genetic technologies in the late 1970s and 1980s, taxonomy or systematics has tended towards the molecular end of the spectrum. For the purpose of identifying ethnotaxa and variation in cryptic species, modern automated identification technology (AIT) such as DNA barcoding may offer a quick, repeatable, and reliable technique. (Newmaster & Raghupathy, 2009). The majority of medicinal plants lack thorough molecular genetic investigations, hence it is essential to perform some early genome assessments before whole-genome sequencing. First, the candidate species could be verified using DNA barcoding techniques; next, karyotypes should be identified by examining metaphase chromosomes; and finally, the ploidy level and genome size could be measured using flow cytometry and pulsed-field gel electrophoresis (PFGE). For instance, using *Oryza sativa* as the internal standard, flow cytometry was utilised to estimate the genome sizes of four *Panax* species. San Qi in traditional Chinese medicine, *P. pseudoginseng, P. vietnamensis, and P. stipuleanatus* all have smaller genomes than *P. ginseng,* with *P. notoginseng* having the largest genome (2454.38 Mb), follow. The genome survey by whole-genome shotgun sequencing is a more trustworthy method for identifying species without the reference genome by *P. pseudoginseng* (2432.72 Mb), *P. vietnamensis, and P. stipuleanatus* (1947.06 Mb) (Hao and Xiao, 2015). Ethnobotany postulates that local systems of classifying living things (which lead to the establishment of cultivars, ethnovarieties, and local categories of date palm) make it feasible for agricultural and classification practices to have significant effects on agrobiodiversity. They are uncommon occurrences, and only molecular genetics analyses might support their claims. The diversity of hidden date palms in Egypt's regions was discovered through ethnogenomics (Balthazard et.al 2020).

Discussion

Indigenous Traditional knowledge is the organised knowledge that has persisted in many societal organizations. Ethnobotanical expertise has traditionally guided natural product development, resulting in the identification of major medications such as asprin, morphine, and artemisinin. This integrative strategy lays the door for new therapeutic discoveries and the long-term use of medicinal plants by combining traditional wisdom with modern scientific advances (Chele et. al. ,2025). Numerous fields, such as bioprospecting, drug development, and biodiversity conservation, could benefit



from ethnobotanical research. For this distinctive traditional learning to be preserved and carried on, it is imperative that the challenges of knowledge loss and sustainable practices be addressed. There are only 710 publications in the field of ethnobotany genomics, roughly 3000 papers on DNA barcoding in plants, and regarding ethnobotany, most of which are about ethnomedicine.

Additionally, there is a requiment to broaden research to encompass understudied areas.(Kiran and Savanur, 2025) There is a critical need for linking the scientific and traditional systems of classification, which are typically unwritten and only passed down orally (khasbagan and Soyolt 2008).

Conclusion

The concept of assemblage of biodiversity knowledge, also regarded as 'ethnobotanical genomics' is a novel approach towards adding value to both traditional knowledge and scientific knowledge. Molecular validation of ethnomedicine is a unique method. It is helpful for the development of new drugs as well as biodiversity conservation and agricultural production. (Varah and Desai, 2021) The use of this method has significantly increased the assurance of the medicinal material's efficacy and safety and authentication.

Conflict of Interest

The authors have not received any funding for preparing this article and there is no conflict of Interest.

Informed Consent

We have not used graphs from other published sources. Information used is cited in the reference section.

Data Availability:

The statistical data presented is available on the official website of the Ministry of Tribal Affairs (Census Report), Government of India.

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