Ethnopharmacology, Herbal Therapeutics, Green Extraction

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Abstract

Ethnopharmacology is a multidisciplinary scientific field that analyses the traditional use of medicinal plants and natural substances by indigenous cultures for the prevention and treatment of diseases. Traditional medicine systems such as Ayurveda, African traditional medicine, and traditional Chinese medicine continue to contribute considerably to modern drug discovery by playing a crucial role in the healthcare industry. Due to their therapeutic potential, lower side effects, and cultural acceptance compared to synthetic drugs, herbal therapeutics are globally recognised as they are derived directly or indirectly from plants. Bioactive phytoconstituents, including alkaloids, terpenoids, flavonoids, phenolic compounds, glycosides, compounds that exhibit multiple pharmacological activities such as anti-inflammatory, antioxidant, antimicrobial, anticancer, antidiabetic and immunomodulatory effects, are used in Herbal Therapeutics. However, standardisation, safety, regulatory approval, and sustainability are still questioned. The compounds that are obtained directly from nature need to be extracted, and here comes the green extraction process. Green extraction is an eco-friendly and sustainable method to isolate bioactive compounds from natural sources. The main focus of green extraction is to produce high-quality herbal extract safely and efficiently. Advanced methods such as microwave-assisted extraction, supercritical fluid extraction, ultrasound-assisted extraction, and pressurised liquid extraction are now widely accepted in herbal drug development. This review discusses the concepts of ethnopharmacology, principles of green extraction technology, the therapeutic importance of medicinal plants, applications in the pharmaceutical industry, regulatory considerations, current challenges, and future perspectives. It also features the importance of sustainable healthcare practices and incorporating traditional knowledge with modern scientific approaches.

Keywords: Ethnopharmacology, Indigenous knowledge, Therapeutic agents, Herbal medicine, Green extraction, Phytoconstituents.

Introduction

The word "ethnopharmacology" comes into existence from Greek words, with "ethno" meaning "people" or "culture" and "pharmacology" meaning "the study of drugs and their biological effects." Ethnopharmacology is a multidisciplinary field that involves the study of medicinal plants from different cultures and communities. Traditional knowledge of medicine is always a prominent healthcare system. Traditional medicine systems such as Ayurveda, traditional Chinese medicine, and the African medicine system have played a vital role in healthcare and continue to contribute further. Today's pharmaceutical industry still follows the traditional and indigenous knowledge of medicine obtained from tribal people. Traditional knowledge has been integrated with modern medicine development to get safer and more effective medicine. There is high demand for herbal therapeutics. Herbal therapy, also known as herbal medicine, is prominent because of its natural origin, fewer toxic effects, and therapeutic potential. Medicinal plants such as Ashwagandha, Tulsi, Neem, Garlic, and Ginger consist of biologically active components that are essential for certain pharmacological actions. As herbal therapeutics are increasing in demand, Green Extraction processes are also gaining importance in herbal drug development. It helps by producing less environmental pollution and excessive solvent consumption. This extraction process is more eco -friendly and sustainable. In this review you will find the definition, advantages, limitations, future perspective, and growing demand of ethnopharmacology, herbal therapeutics, and green extraction processes.

1. ETHNOPHARMACOLOGY

Ethnopharmacology is a scientific field that studies biologically active compounds used by indigenous peoples and local communities. It combines knowledge from different areas, including pharmacology, anthropology, botany, toxicology, chemistry, and medicine, to evaluate the medicinal potential of natural substances. Ethnopharmacology connects traditional healing practices with modern pharmaceutical systems. Daniel Efron and his colleagues first introduced the term in 1967 as the title of a book about hallucinogenic substances: Ethnopharmacological Search for Psychoactive Drugs. Many current medications come from the traditional use of medicinal plants, showing the value of indigenous knowledge. This field mainly aims to support the safer and more effective development of herbal medicines in the healthcare system. Recent research indicates a significant demand for these products**.**

1.1 Historical Background

19TH CENTURY

The development of Ethnopharmacology began in the 19th century. Scientists started their study by doing experiments on the natural substance used by indigenous people. As we know, the ancient healthcare system has a great influence on the modern drug system it provides valuable information about traditionally used plants. The following are the healthcare system and its effects on the body.

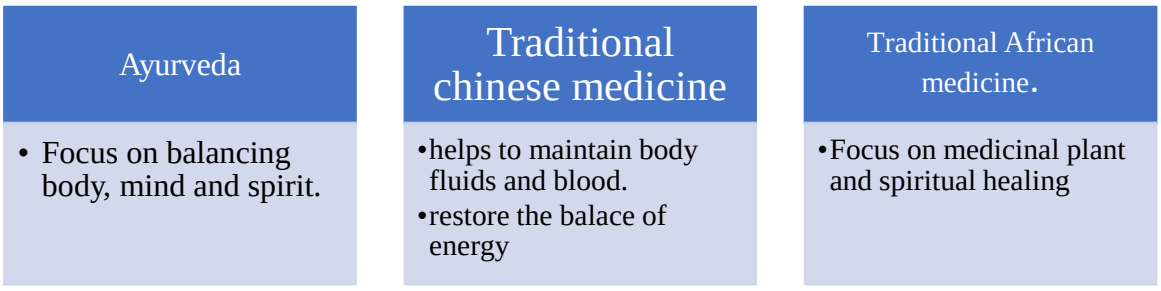


Figure 1.1.1: 19th-century healthcare system.

The very first example that was taken into consideration was.

EXAMPLE:-**curare**

SOURCE:-It is obtained from the woody vine of strychnos toxifera.

FAMILY :- alkaloids

USES:- It is used as a neuromuscular blocking agent, working as a skeletal muscle relaxant in modern medicine

- previously, it was used as arrow poison in wild games by the tribe people in South America
- Claude Bernard underwent pharmacological studies that demonstrated action on muscular paralysis, and later found the active compound tubocurarine.

- **MOA :-** :- It is a neuromuscular blocking agent compete with acetylcholine (neurotransmitter) and causes skeletal muscle relaxation.

This prevents activation of skeletal muscle, and relaxation in skeletal muscle is observed

- Relaxation starts from the toes, ears, and eyes progress toward muscles in respiration.

20TH CENTURY

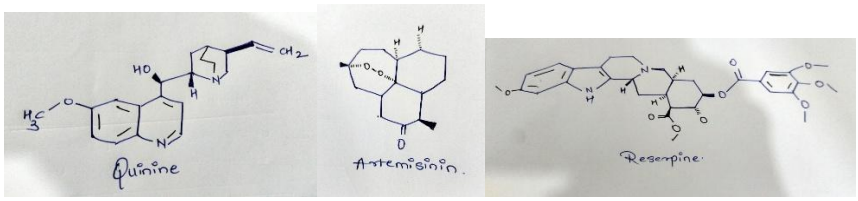
In the 20th century, ethnopharmacology became the foundation for many life-saving medicines. Researchers successfully integrated the indigenous medicine with modern medicines by analysing, extracting and synthesising appropriate active constituents.

Following are the drugs developed in 20th century.

Table 1.1.1: drug developed in 20th century.

DISEASE	ACTIVE CONSTITUENT	SOURCE
1.Malarial treatment	Quinine, Artemisinin.	-From the bark of the Cinchona tree. -Extracted from Artemisia annua.
2.Cancer Therapeutics	Vinca alkaloids paclitaxel	-vincristine and vinblastine were isolated from the Madagascar periwinkle [Catharanthus roseus] -extracted from the bark of pacific yew tree [Taxus brevifolia]
3.Neurological and psychiatric medicines	Reserpine	-Extracted from the roots of the Rauwolfia serpentina shrubs. -It is used as a tranquillizer and an antihypertensive drugs.
4.Muscle relaxants.	Turbocurarine	-Extracted from Chondrodendron tomentosum.

STRUCTURES:-



1.2 Importance of Ethnopharmacology.

Ethnopharmacology has contributed greatly to modern drug discovery. There are various drugs like quinine, morphine, codeine, digitalis, glycoside, are originated from Ethnopharmacological observation. These observations are a proof of how indigenous knowledge makes a valuable contribution in modern drug discovery and the development of therapeutic agents. This field plays a vital role in minimising the randomness of drug screening by focusing on already existing plants for their medicinal use. The following are a few importance of Ethnopharmacology.



Drug Discovery

Preservation of indigenous knowledge and cultural heritage

Development of herbal therapeutics and complementry medicines.

Conservation of biodiversity and sustainable use of medicinal plant.

Figure 1

Overall, ethnopharmacology has notable remarks because it upgrades scientific modernisation, preserves and nurtures traditional knowledge, supports healthcare development, and encourages sustainable utilisation of natural medicinal resources

1.3 Applications

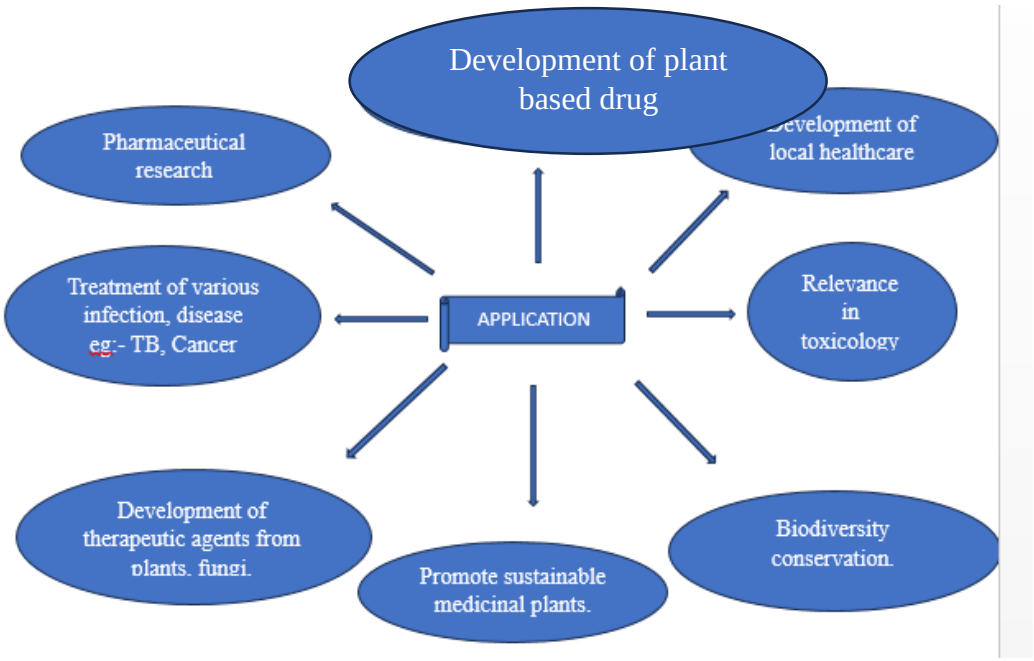


Figure 1.1.3: Application of ethnopharmacology.

1.4 Future Perspective

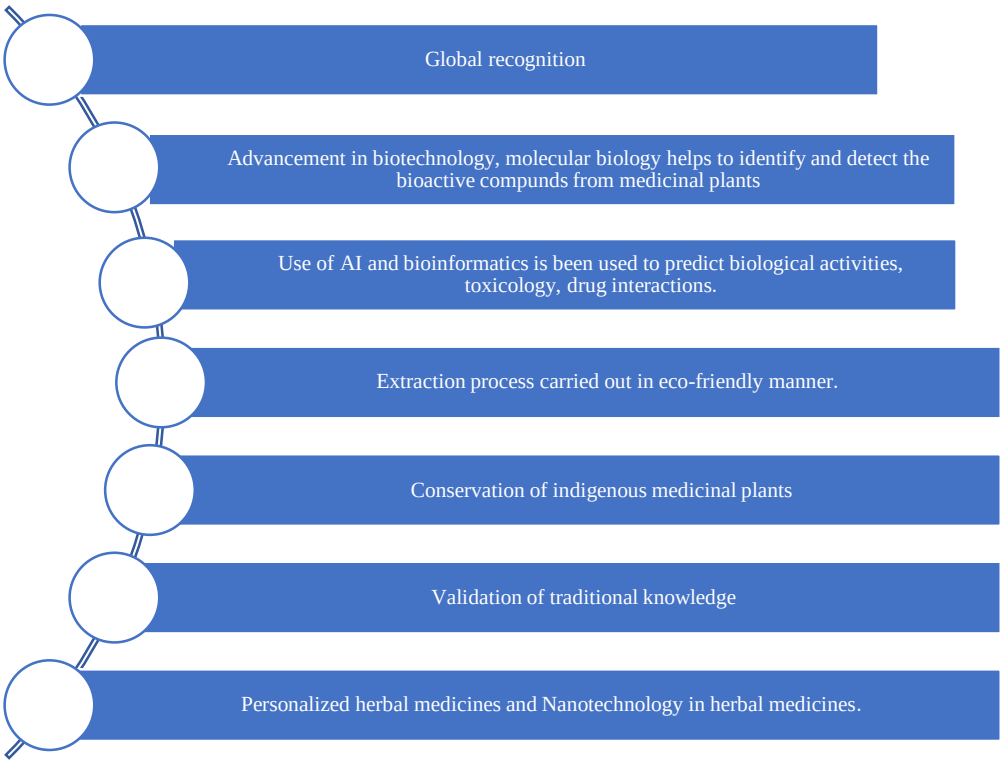


Figure 1.1.4: Future perspective of ethnopharmacology.

1.5 Ethnopharmacology Drug Discovery Pipeline

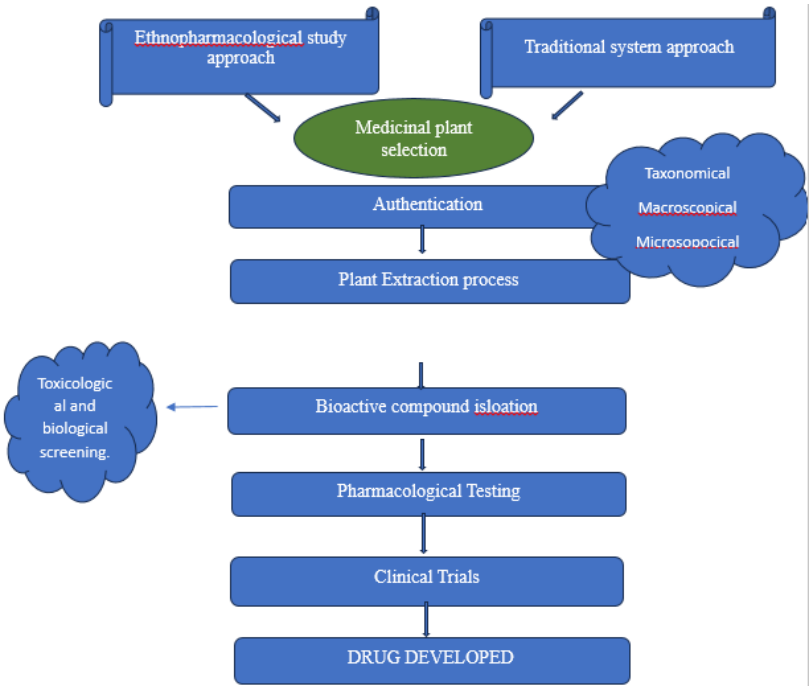


Figure 1.1.5 Drug discovery pipeline in ethnopharmacology.

2] Herbal Therapeutics

2.1] What are Herbs?

"Herbs include crude plant material such as leaves, flowers, fruits, seeds, stems, wood, bark, roots, rhizomes, or other plant parts, which may be entire, fragmented, or powdered."

2.2] What are Herbal Therapeutics or Herbal Medicines?

"Herbal medicines are finished, labelled medicinal products that contain active ingredients obtained from plant parts or other plant materials, or combinations of these."

2.3] Sources

Herbs can mainly obtained from 2 sources

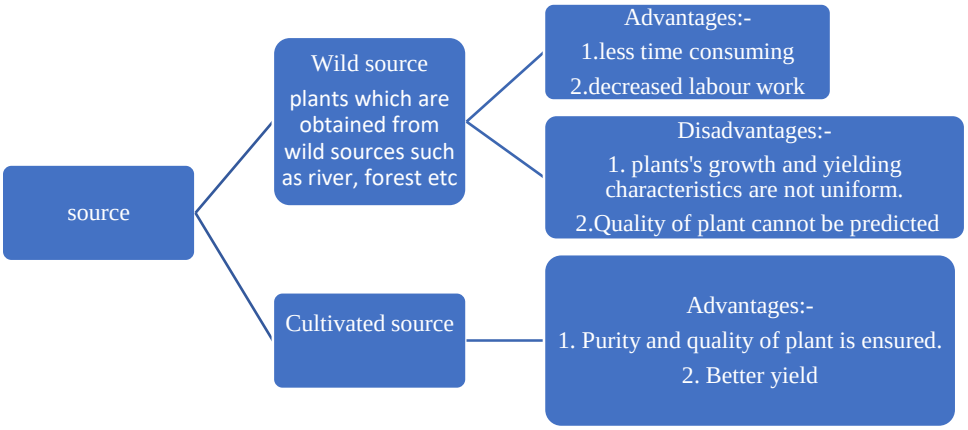


Figure 2.2.3: Sources of Herbal therapeutics.

- **The article highlights the growing demand for herbal medicines due to:**

1. Increasing awareness of natural treatments
2. High cost of synthetic drugs
3. Side effects associated with allopathic medicines.
4. It also explains the role of the World Health Organisation (WHO) in promoting traditionaledicine and assuring the safety, efficacy, and quality of herbal products or herbal drugs.

2.4] Disease Herbal therapeutics and its therapeutic acion:

Table 2.2.4: Disease herbal therapeutics and therapeutic action

Sr no.	Disease	Herbal therapeutics	Therapeutic Action
1.	CVS	Garlic (Allium sativum), Arjuna (Terminalia arjuna)	Prevents cancer cell proliferation and boosts immunity by protecting cardio cells also reduces cholesterol level.
2.	Hypertension	Garlic (Allium sativum), Rauwolfia (Rauwolfia serpentina)	Lowers blood pressure and reduces heart activity.

3.	Diabetes mellitus	Bitter Gourd (Momordica charantia) Fenugreek (Trigonella foenum-graecum) Neem (Azadirachta indica)	Helps in reducing blood glucose level & improves insulin activity
4.	Arthritis	Turmeric (Curcuma longa), Ginger (Zingiber officinale)	Helps in pain relieving function & acts as anti-inflammatory drug.
5.	Respiratory disease	Tulsi (Ocimum sanctum), Licorice (Glycyrrhiza glabra).	Helps in Relieves of cough, cold, and bronchitis.
6.	Skin disease	Neem (Azadirachta indica), Aloe vera (Aloe barbadensis)	Shows wound healing effect & acts as anti - microbial drug
7.	Gastric ulcer	Licorice (Glycyrrhiza glabra), Flaxseed (Linum usitatissimum), Ashwagandha (Withania somnifera)	Helps in reducing inflammation & protects gastric mucosa
8.	Infectious disease	Tulsi (Ocimum sanctum), Neem (Azadirachta indica), Turmeric (Curcuma longa).	Shows anti-bacterial & anti-vital activity.
9.	Anxiety and stress	Ashwagandha (Withania somnifera), Chamomile (Matricaria chamomilla)	Shows mild sedative & calming effect.
10.	Liver disorder	1iloy (Tinospora cordifolia), Bhumyamalaki (Phyllanthus niruri)	Shows anti- oxidant activity. Protects lever cells and useful in jaundice.
11.	Cancer	Catharanthus (Catharanthus roseus), Digitalis (Digitalis lanata)	Used in leukemia and lymphoma. increases force of heart contraction and regulates heart rhythm.

2.5] Quality Control Test

Mainly quality control test is based on 3 pharmacopoeia definition -



Figure 2.2.5: Quality Control Test.

2.6] Parameters for QC tests for herbal drug.

1. Macroscopic test/examination

2. Microscopic test/examination

3. Determination of foreign matter.

4. Determination of heavy metals

5. Determination of microbial contamination

6. Determination of pesticide residue

7. Determination of ash value

a. Total ash value

b. Water soluble ash

c. Acid insoluble ash.

d. Sulphated ash.

2.7] Future Perspectives of Herbal Therapeutics

1] Increasing demand of modern and herbal medicines.

2] Integration of herbal medicines with modern healthcare systems.

3] Development of standardized and scientifically validated herbal formulations.

4] Use of advanced technologies like nanotechnology and biotechnology in herbal drug delivery.

5] Growing research on phytochemicals for chronic diseases such as cancer and diabetes.

6] Herbal Medicines can be personalized based on genetic and lifestyle factors.

7] Main focus on quality control, safety, efficacy and clinical trials of herbal therapeutics.

8] Due to fewer side effects there is increase in worldwide acceptance of herbal drug.

2.8] Critical Evaluation

2.8.1] Strengths

1. Helps in providing scientific evidence that supports traditional medicine.

2. Helps in a detailed study on phytochemicals.

3. Detailed study on herbal therapeutics & medicinal plants.

2.8.2] Limitations

1. Standardisation & dosage variation remain major issues
2. Some herbal medicines may lack in clinical trials.
3. There is a high possibility of herb-drug interaction contamination

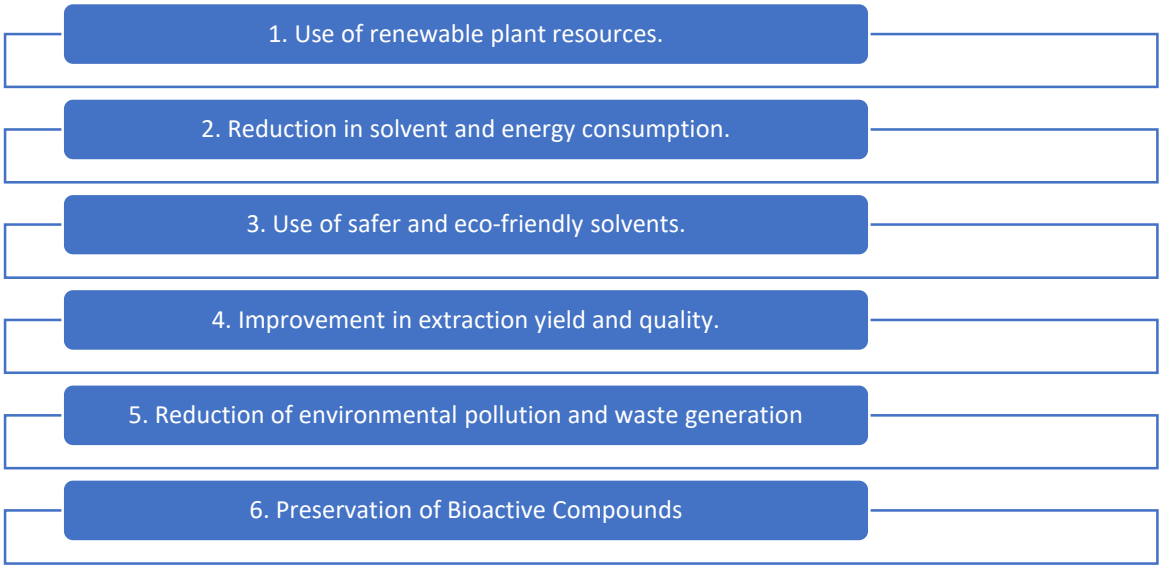
3. Green Extraction Technology

3.1] What is Green Extraction?

Green Extraction is the technique by which phytoconstituents are extracted from natural sources, which helps in minimising the amount of solvent needed and amount of waste generated during the process of green extraction.

Nowadys, medicinal plants are getting on high demand due to its characteristic features as an ample source of curative phytochemicals which can be used for herbal drug preparation.

3.2] Principle Following are the main principles of green extraction -



. Figure 3.3.2: principle of Green Extraction.

3.3] Modern Method of Extraction-

1]Extraction is the technique by which soluble materials are isolated from insoluble residues.

2]Extraction process can be solid-liquid or liquid-liquid extraction.

° **General extraction process**

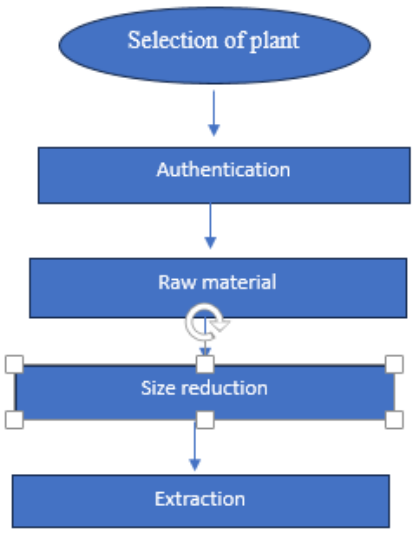


Figure 3.3.3: General Extraction process

3.4] Methods of Green extractions.

Table 3.4.1: Methods of Green extractions.

Sr no.	Solvents	Extraction technique
1.	Solvent-free	Microwave Hydro-diffusion and gravity (essential oils) Pulse Electric field (antioxidants, pigments)
2.	water	Steam distillation, Microwave distillation (essential oils) Extraction by subcritical water (Aromas).
3.	Co2	Supercritical fluid extraction (decaffeination of tea and coffee).
4.	Ionic liquid	Ammonium salts (Artemisinin)
5.	Agrosolvents	Ethanol (pigments and antioxidants) Glycerol (polyphenols) Terpenes such as d-limonene (fats and oils)
6.	Petrochemicals solvents	n-Hexane

3.5] Properties:-

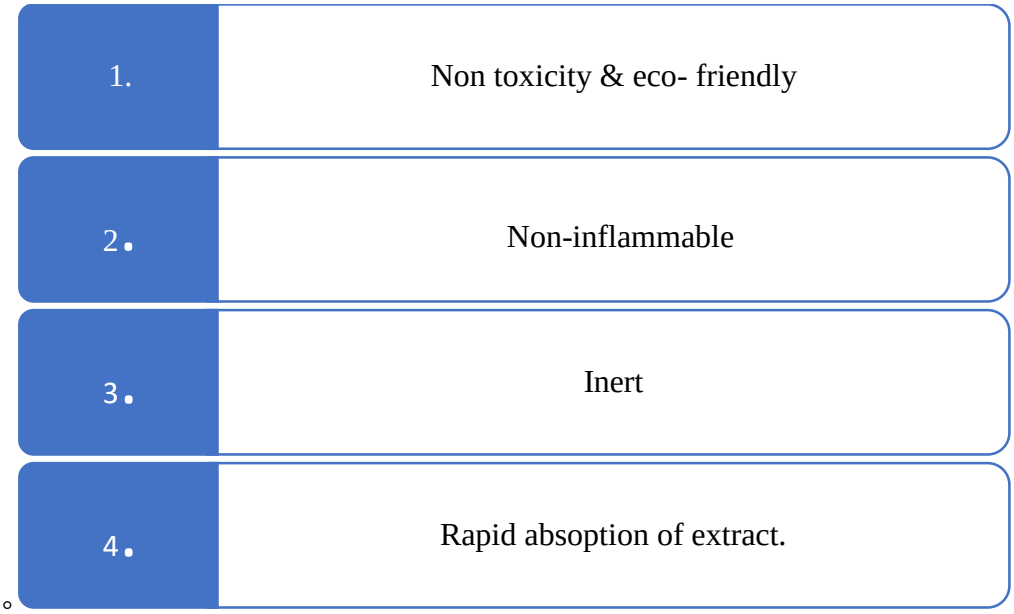


Figure 3.3.4: Properties of Green Ex traction.

3.6] Advantages of Green Extraction:-

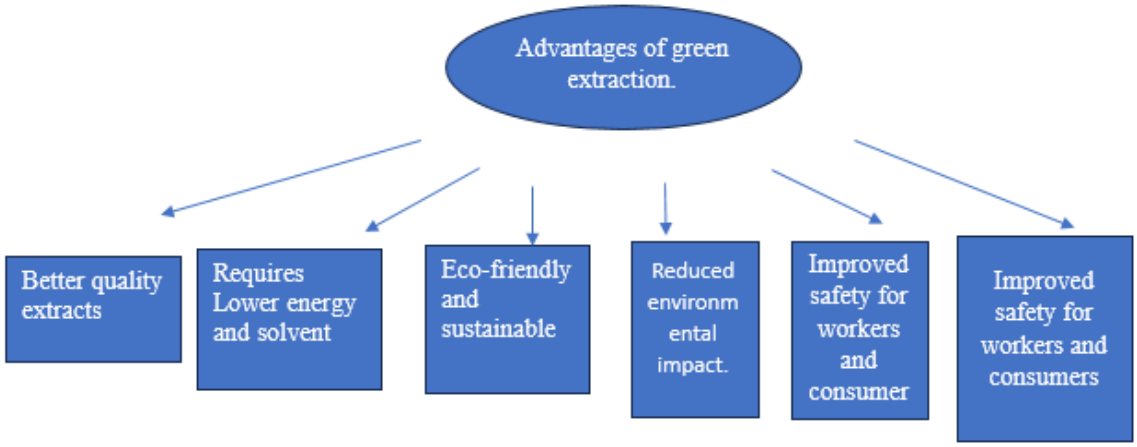


Figure 3.3.5: Advantages of Green extraction.

3.7] Limitation:-

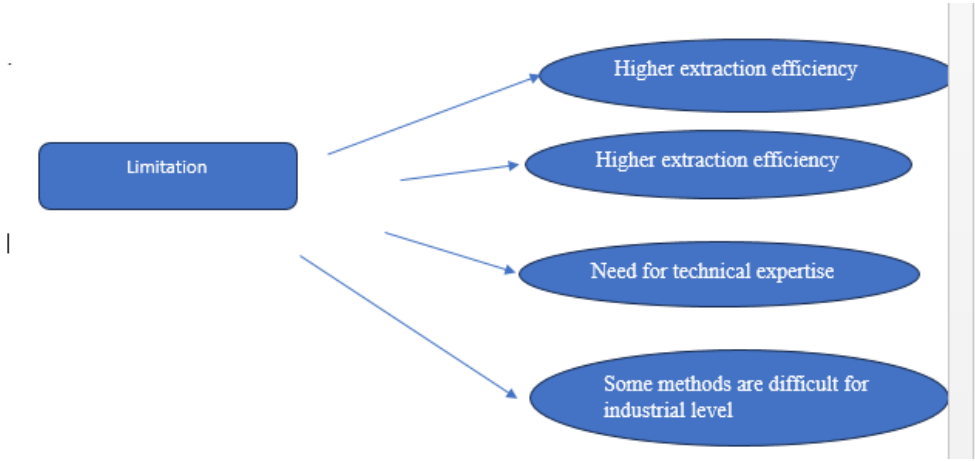


Figure 3.3.6: Limitation of Green Extraction.

3.8] Applications in Herbal & Pharmaceutical Industry -

1.Cosmetic formulation

2. Nutraceutical Product

3. Herbal Drug Preparation

4. Food & Beverage preservation

5. Flavour Extraction

6. Natural product drug discovery.

Himalaya Wellness

Dabur India

Patanjali Ayurveda.

3.9] Regulatory and Quality Control Aspects

The World Health Organisation (WHO) have set some guidelines for the safe and effective production of herbal medicines.

Before the product is marketed, it is necessary to check all the parameters related to safety, quality, and efficacy. Therefore, Good Manufacturing Practice [GMP] is essential to ensure the quality and safety of herbal drugs. ICH guidelines are set for ensuring the quality, safety and efficacy of the drugs.

Quality control measures include:

- Botanical identification
- Phytochemical screening
- Standardization of active compounds
- Stability studies
- Microbial testing
- Toxicity evaluation

3.10] Challenges and Future Perspectives

Challenges:-

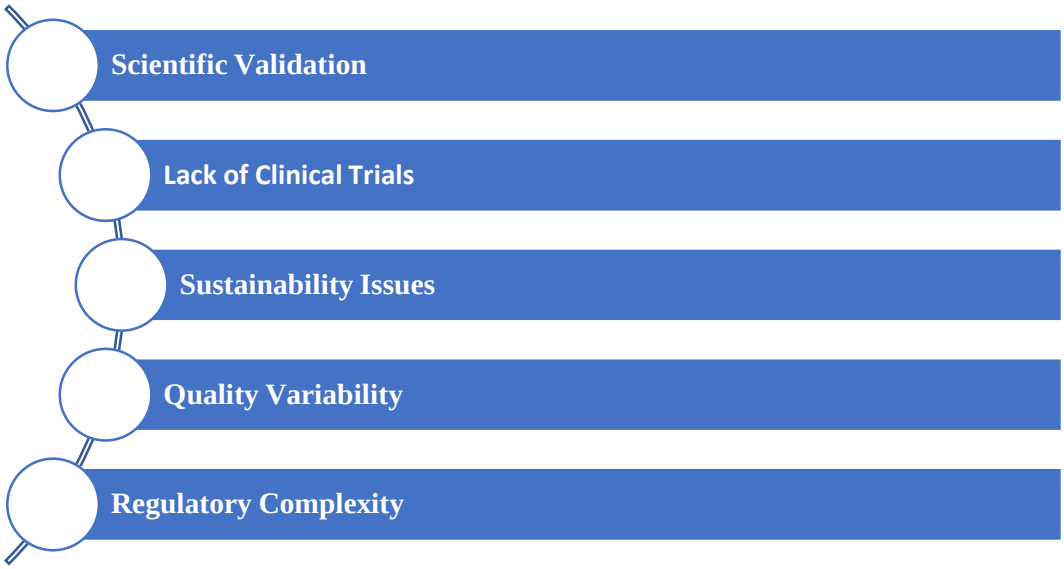


Figure 3.3.10: Challenges

- **Future Perspectives**

Artificial Intelligence in Herbal Drug Discovery

Nanotechnology in Herbal Therapeutics

Sustainable Extraction Innovations

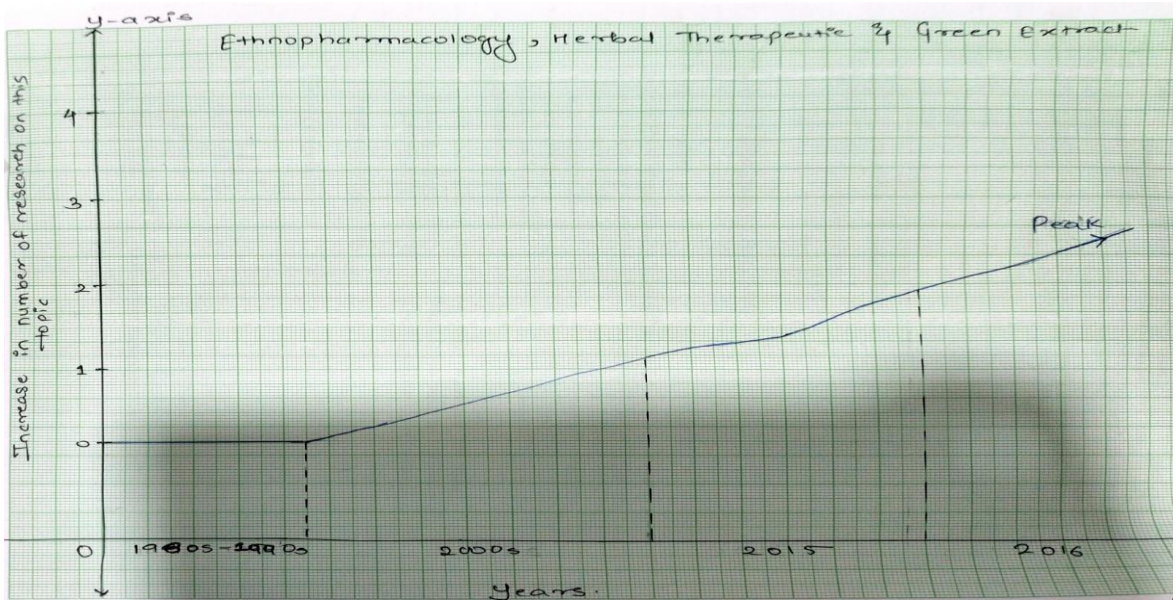
Personalized Herbal Medicine

Biodiversity Conservation

Conclusion

Ethnopharmacology plays a crucial role in producing safe and effective medicine from the indigenous knowledge, while minimising the toxic effects, enhancing the therapeutic effects and discovering new therapeutic agents from natural resources. Herbal therapeutic also known as herbal medicine, is booming worldwide because of its natural origin, therapeutic potential and patient acceptance. Medicinal plants contain various phytoconstituents like anti-inflammatory, anticancer, antimicrobial, antidiabetic, muscle relaxant, etc. As the acceptance rate of herbal therapeutic is increasing day by day, the methods of extracting the active constituent from the medicinal plant are also being enhanced. By performing the Green Extraction process, we get a low amount of waste generation and increase the chance of extracting the appropriate active compound.
Green extraction is an eco-friendly process. Despite all these advantages, there are Challenges related to standardisation, purity, quality, Clinical validation, and sustainability that remain considerable. These can be overcome by following appropriate Regulatory guidelines for maintaining the required quality, safety, and efficacy. Also, the new technologies that are taking over the market are beneficial for predicting the toxicological effects and therapeutic potential of medicinal plants. Also, advancements like AI, biotechnology, and nanotechnology help to develop personalised medicine. The integration of traditional knowledge with modern drug development contributes to the development of a more
sustainable and effective HealthCare system worldwide.

- Following graph shows the increasing trend of research papers in the field of Ethnopharmacology, Herbal therapeutics and Green extraction:-



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