



# UPDATED REVIEW ON ADVANCED HERBAL TECHNOLOGY

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## ABSTRACT

Due to various benefits, people are becoming more interested in herbal medications nowadays. Formulations made from herbs are now widely accepted as effective treatments for many ailments. Even if the majority of these uses are unconventional, it is a known fact that more than 80% of the world's population relies on herbal products and medicines to maintain a healthy lifestyle. The increased usage of herbal goods has also led to a variety of product abuses and adulterations, which have disappointed consumers and manufacturers and, in some cases, had disastrous results. Scientists face a significant difficulty in developing reliable analytical techniques that can quantitatively analyse marker/bioactive chemicals and other important ingredients and reliably profile the phytochemical makeup. An essential step for the establishment is standardisation.

## Key Words:

Authentication, Chromatography, Extraction, Purification, Standardization, Herbal technology, Herbal medicine. (1)

## Objective

- Recognize the various approaches utilised in advanced herbal medication technology.

## Introduction

The fundamental ideas of the widely used herbal technology are covered in this article (2). The demand for alternative medicine has led to an expansion of the natural product market and traditional medical practises. Standardization and quality control with adequate integration of contemporary scientific techniques and traditional knowledge are crucial when using herbal medication technology to turn plant ingredients into medicines (3). The term "herbal" refers to a botanical or plant-based preparation, whereas "medicine" refers to a material that possesses nutritional, therapeutic, or preventative characteristics. Consequently, plant-based medicines that have nutritional, curative, or preventative properties are referred to as "herbal medicine." is applied to plant-based substances that have nutritional, therapeutic, or preventative qualities. As it encompasses all areas of herbal medicine related to botany, medicinal plant research, pharmacognosy, phytochemistry, phytotherapy, botanical medicines, Ayurveda, natural chemistry, agriculture science, Unani medicine, biotechnology, and biochemistry, herbal medicine is an interdisciplinary branch between herbal medicine and Ayurveda. An herbalist is a person who works with plants, particularly medicinal plants. The use of plants to treat disease is covered in herbal journals. (1)

## **Different techniques for plant identification**

### **Expert Determination:**

The most reliable and accurate form of identification is expert determination. In general, professionals have created treatments (monographs, revisions, synopses) of the relevant group, and it is likely that the ideas of taxa used by experts are included in more recent floras or manuals. In botanical gardens, herbaria, museums, colleges, universities, etc., experts are frequently found. Although extremely reliable, this method has drawbacks in that it consumes specialists' valuable time and delays identification.

### **Recognition:**

In terms of dependability, it is comparable to expert judgement. This is based on the identifier's in-depth prior familiarity with the identification of the plant group.

### **Comparison:**

A third technique involves comparing an unknown to known specimens, pictures, drawings, or descriptions. Despite being a reliable procedure, because there aren't enough comparable materials, it could be exceedingly time-consuming or even impossible.

### **Utilization of Keys and Comparable Instruments (Synopses, Outlines, etc.)**

This approach is by far the most popular because it doesn't require the time, , or expertise needed for comparison and recognition.(4)

### **Plant identification**

Herb authentication is a technique of quality control that makes sure the right kinds of plants and plant components are utilised as the foundation for herbal medications.(5).The fundamental basis for making a botanical product is authentic raw material. Additionally, each stage of harvest, storage, processing, and formulation has the potential to significantly change the final product's uniformity and quality. As a result, techniques for ensuring quality control throughout production and storage are essential instruments to guarantee these goods' maximum efficacy and safety.

### **Taxonomic approach:**

Traditional botanical procedures for gathering and documenting the plant at its source are required as the first stage in the identification and verification of botanical materials. The drug's botanical source is revealed, and its scientific Latin name this technique, the binomial (i.e., genus-species) name is established. It serves as the initial stage in authentication. The necessary conditions even before verification include data such as botanical name, ve resources rnacular names, location of plant material collection, collector details, habitat, season of collection, altitude, and part gathered, among others.

### **Sample of a herbarium voucher**

The sample of material should be stored as a backup sample in a herbarium or research facility.

### **Macroscopic**

The comparison of morphological characteristics that can be seen with the unaided eye or under low magnification with descriptions of the plant or botanical drug in floras or monographs is known as a macroscopic inspection. For macroscopic identification, traits like the size, shape, and colour of leaves (or leaf fragments), flowers, or fruits are frequently used.

## Microscopic

The focus of a microscopic investigation is on anatomical structures in plant material that can only be seen under a microscope. The shape and structure of trichome (hair), the arrangement of stomata in the epidermis, the presence or absence of substances like mucilage, starch, or lignin, or the existence of tissues with distinctive cells may all be used to identify herbal medications under the microscope.

## Chromatography

Chromatography: Chemical separation a mixes of chemical chemicals The majority of pharmacopoeial monographs for plants include a TLC identification test since thin-layer chromatography (TLC) is frequently used in the authentication of herbal materials. TLC separates mixtures of substances to leave a silica gel-coated plate with a "fingerprint" of the separated substances. A pure reference compound or an authentic sample can be used to compare this fingerprint to.

## Extraction techniques

### Extraction

Extraction is the process of using a liquid solvent to separate soluble material from an insoluble residue, which can be either a liquid or a solid. Therefore, it is a process for finding a solution that depends on the mass transfer phenomenon. The rate at which the solute diffuses through the liquid boundary layer at the interface typically determines the extraction rate.

The primary extraction techniques are:

- Maceration
- Percolation
- Digestion
- Infusion
- Decoction(1)

### Extracting Supercritical Fluid

With the aid of a solvent, a component is extracted from a matrix in this type of extraction. However, supercritical fluid is the solvent in this instance. Supercritical Fluid Extraction (SCF) is typically used to extract materials from solids, but it can also be used to extract materials from liquids. In analytical laboratories, this kind of extraction is employed to prepare samples. On a wider scale, it is utilised to remove undesirable substances from the product stream (decaffeination) (oil) The separated chemicals or compounds are mixed with the supercritical fluids in this extraction process to create a mobile phase. The solvating properties of the mobile phase are improved at pressures and temperatures that are close to the critical pressure and temperature values. Extracting Supercritical Fluid It is easy to use the supercritical fluid extraction method. Quick extraction takes between 30 and 60 minutes per sample, which is a third and a quarter less time than traditional methods. With this method, traces of pesticides are removed, and the extract is gathered in a trap column. The trap column can also be used to separate minimum extract. After each set of operations, the trap column and pipes are cleansed, ensuring minimal obstructions and contamination in the column. For SCF Extraction, carbon dioxide is a highly pure, low-cost extracting solvent. Due to the non-toxic and inflammable nature of carbon dioxide, this method is secure and environmentally benign. SFFs' physical and thermal characteristics fall in between those of pure liquid and gas, hence they can additionally referred to as "dense gases" or "Compressible liquids"

### changes to a SCF's attributes

- Densities appeal to liquids (100-1000 times greater than gases).
- Diffusivities ( $10^{-3}$  and  $10^{-4}$  cm<sup>2</sup>/s) greater than those of liquids.
- decent solvating capacity. surface tension reduction.
- a thin viscosity (10-100 times less than liquids).
- They have tremendous penetrating power because of their gas-like compressibility features.

### Advantages

- SCF Extraction has the advantage of reducing storage concerns by getting rid of organic solvents.
- This method is also appropriate for the extraction and purification of low-volatility solid or liquid substances.
- Additionally, it is vulnerable to thermal deterioration (low operating conditions).
- SCF extraction is a flexible and effective method (use of co-solvents and co-solutes)

### Disadvantages

- the moment (penetration of SCF into the interior of a solid is rapid, but solute diffusion from the solid into the SCF).
- Complicated recycling procedures are needed for solvent compression in order to save money on energy.
- Scale is impossible because the principles are missing.
- molecular-based model of the SCF's solutes
- It will take time to clean.
- It is challenging to keep the SCF under pressure.

### Microwave extractions

Principles magnetic waves, also known as microwaves, are made up of two perpendicularly oscillating fields: the electric field and the magnetic field. These waves can carry information or act as energy vectors. The material absorbs electromagnetic waves, which it then transforms into heat energy. This energy is a microwave. The range of microwave energy is 300 MHz to 300 GHz. These waves are radiation that cannot ionise. There are two ways that electromagnetic energy can be transformed into caloric energy or heat: Dipole rotation and Ionic Conduction

### Process

#### Microwave Extraction Method

Dried plant material is utilised for extraction, thus even though it is dried, it still includes some moisture. Due to the microwave incident, the moisture content heats up and the internal pressure rises. The plant cell wall is under strain, which causes the cell to swell. Further pressure increase causes the cell to break, which results in the components being leached with the solvent. The efficiency of heating rises if the solvent has saturated the plant matrix. The two types of instruments used in microwave-assisted extractions are focused microwave ovens (where just a portion of the extraction vessel is exposed to radiation) and closed extraction vessels (where extraction takes place in a controlled environment).

## Factor affecting microwave extractions

### Solvent

A excellent extraction yield is the product of careful solvent selection. The Microwave Extraction technique uses solvents like Dichloromethane, Methanol, Acetone, Petrol Ether, etc. The solvents should have a high degree of selectivity for the analyte. The extraction solvent needs to work with the chromatographic processes. The process is also impacted by the solvent's dielectric characteristics and volume. Therefore, it is crucial to optimise this element.

### Extraction time:

As the number of analysers rises, so does the extraction time. After a certain amount of time or recovery from extraction, this also leads in a rise in the danger of degradation; further extraction will cause the degradation of crucial constituents. The extraction time varies depending on the plant matrix employed Microwave power:

### Microwave power

A sufficient amount of microwave power should be provided; neither considerably more nor much less than necessary. This is dependent on the effectiveness of the power-based extraction. And its exposure period. Optimization is carried out using trial-and-error techniques and experimental data.

### Microwave Characteristics

properties of the matrix 100 m to 2 mm in size, extracted material. Greater surface area, finer particle, and more efficient extraction Therefore, the matrix's size and its initial moisture content both have an impact on the process.

### Temperature and Pressure:

As the temperature and pressure rise, the solvent's solubility increases and its surface tension and viscosity decreases. High extraction recovery is caused by the matrix's leaching of Phytoconstituents. Pressure is a crucial aspect to take into account because it depends on temperature.

### Application

- The chemicals that can be extracted using this method are listed below.
- flammable oils *Mentha piperita*, *Thuja occidentalis*, and Modified Domestic Oven make up the matrix.
- Transparent solvents are used to conduct the extraction.
- Ethanol - Matrix: *Cyclocarya paliurus* and *Pistacia lentiscus* leaves, Systems: Open and Closed Vessel, respectively. The extraction for open vessels is done at a power of 600W.
- Fruits of *Citrus seninsus*, System: Open vessel, Acetone Matrix

### Principles of the ultrasound extraction process (sonication)

Ultrasound waves with frequencies between 20 to 2000 kHz are used in this procedure to increase cell permeability and create cavitations. Although this method is effective in a variety of situations, such as the extraction of anthocyanins and antioxidants and in the field of nanotechnology, its usage in the extraction of *ruwolfia* root is restricted due to its high cost.

## Advantages

- The extraction of thermolabile chemicals is made possible by ultrasound extraction, which also involves faster kinetics and lower operating temperatures.
- The materials utilised are effective, economical with their usage of solvents, and boost the sample's throughput.
- The recovery and purification of active components using the ultrasound extraction approach is also effective.
- The ultrasound apparatus is less expensive and simpler to use than other cutting-edge extraction methods like microwave-assisted extraction.

## Disadvantages

- These procedures involve the sporadic but well-documented harmful impact of ultrasound energy (greater than 20 KHz) on the active components of medicinal plants. This occurs when free radicals are formed, which leads to unfavourable changes in drug molecules.

## Application

- Cell disruption and crude oil desulfurization both involve ultrasound extraction.
- Initiating crystallisation processes and even controlling polymorphic crystallisation are both possible with sonication.
- This process is also used to create nanoparticles such Nano emulsifiers and biofuels.

## Using solid phase extraction

Depending on the components' physical and chemical characteristics, solid phase extraction is a sample preparation technique used for the isolation, enrichment, and purification of components from aqueous solutions. A solid phase or sorbent is used to contact aqueous samples in this process, where the substance is adsorbed on the surface of the solid phase before being eluted. In comparison to the amount of analysis in the sample, the extract amount is insignificant. The practise of solid phase extraction is common in analytical laboratories.

Additionally, it solves problems with the liquid-liquid extraction process, such as unsatisfactory phase separation, low recovery, and excessive organic solvent waste. Additionally, the glassware used in liquid-liquid extraction is pricey.

Sorbent is a substance that is used to adsorb or absorb various fluids.

### Steps involved in Solid Phase Extraction

The Solid Phase Extraction Operation is divided into five steps as follows:

Step 1: Wetting of Sorbent.

Step 2: Conditioning of sorbent.

Step 3: Loading of sample.

Step 4: Interference Elution.

Step 5: Analytic Elution.



Rinse the SPE tube with sorbent and then fill it up with enough sorbent. Conditioning of the sorbent, in which the solvent or buffer is applied, comes next. The loading of samples comes next. Suction is used to pull the sample through the sorbent material (Vacuum or plunger). After this step, the undesired material is eliminated by separating one substance from another during a solvent wash (Elution). This aids in the required sample's extraction. Finally, using an elute solvent, the desired sample is removed from the sorbent (6)

## Technique for isolation and purification

- Typical isolation strategies
- Extraction strategies
- The separation of natural plant components and their purification involve the extraction of plant material.
- Plant matrices are inherently complex, including a large range of substances with different physical and chemical characteristics [8]. Therefore, it is essential to thoroughly separate pure chemicals of interest from the rest of the plant in order to characterise them. is classifiable [9]. They have been divided into groups in this chapter according to the temperatures they operate in.
- Methods at low or ambient temperatures
- technique of cold extraction
- Literature has described the procedure. Specifically, samples of dried plant parts (Cut, crushed or milled)(1)

## Chromatographic process

### Introduction

One of the most important bioanalytical methods utilised in the various fields of chemistry and the life sciences is chromatography. It enables the qualitative and quantitative separation, identification, and purification of the compounds of various origin, class, and nature from a complicated mixture. Based on its capacity in terms of its binding specificity, a molecule with the necessary shape, size, charge, and groups can be separated. Its widespread application in separation science has made it one of the adaptable techniques with a variety of versions that are successfully applied to separation in both the laboratory and on an industrial scale. The various chromatographic techniques were briefly discussed in this chapter based on their bed form, various phases, separation mechanism, concept, procedure, and application. Additionally, various specific methods that provide chromatography a new dimension were highlighted (7)

## Thin layer chromatography

A "solid-liquid ad-sorption" chromatography is thin-layer chromatography. This method uses glass plates coated with solid adsorbent as the stationary phase. All solid materials used in column chromatography, such as silica gel and cellulose, can be used as adsorbent materials. In this procedure, the solvent moves up the thin plate that has been saturated with the solvent as the mobile phase moves higher through the stationary phase. During this process, the mixture is also forced upward at various flow rates after being previously dropped with a pipette on the lower portions of the plate. we are able to separate the analytes. Its upward travelling rate is dependent on the polarity of the substance, solid phase, and solvent [16] If the sample's molecules lack colour, their positions on the chromatogram can be determined by using florescence, radioactivity, or a particular chemical to create a visible coloured reactive result. Under ambient or UV light, a discernible colour can be seen forming. By computing the ratio between the lengths travelled by each molecule and the solvent, one can determine the position of each molecule in the mixture. Relative mobility is a measuring value that is denoted by the symbol  $R_f$ .  $R_f$  value is used to describe compounds qualitatively.

## Column chromatography

If the sample's molecules are colourless, it is still possible to discern their positions on the chromatogram by utilising fluorescence, radioactivity, or a specific chemical to produce a clearly visible, coloured reaction. It is possible to detect a recognisable colour forming under ambient or UV light. The position of each molecule in the mixture can be calculated by dividing the lengths travelled by each molecule by the solvent.  $R_f$  is a measurement value that stands for relative mobility.  $R_f$  value is used to qualitatively describe substances. Their movement through the interior column material, which is supported by fibre glass, is ensured. At the device's base, samples are gathered in a volume- and time-dependent way.

## High performance liquid chromatography

This chromatography method yields perfect results in the separation and identification of amino acids, carbohydrates, lipids, nucleic acids, proteins, steroids, and other biologically active molecules. It allows for the structural and functional analysis, as well as the purification, of many molecules in a short amount of time. In HPLC, mobile phase moves quickly (0.1–5 cm/sec) across columns while being compressed to 10–400 atmospheres. With this method, the analysis is finished quickly thanks to the utilisation of small particles and the application of high pressure to the rate of solvent flow. a crucial element of an HPLC device Depot for solvents, high-pressure pump Commercially made detector, column, and recording. With the use of a computerised system, the separation's duration is managed, and the materials are precise (8)

## High performance thin layer chromatography

A more advanced type of thin layer chromatography is high-performance thin-layer chromatography (HPTLC) (TLC). The fundamental thin-layer chromatography technique can be improved in a number of ways to automate the various procedures, boost the attained resolution, and enable more precise quantitative measurements. When a sample is put manually to a TLC plate, there is a chance that the droplet size and position will be unpredictable. The application of the sample using piezoelectric devices and inkjet printers is one method of automation. ] Using two-dimensional chromatography, the spot capacity (corresponding to peak capacity in HPLC) can be improved by developing the plate with two distinct solvents. [The process starts with the plate containing the sample and first solvent developed. The plate is then removed, rotated 90 degrees, and developed using a different solvent.

With the aid of detection and data capture, natural compound separation is accomplished using planar chromatography on high performance layers. Pre-coated plates coated with a sorbent with a particle size of 5–7 microns and a layer thickness of 150–200 microns make up these high performance layers. The efficiency of the plate as well as the type of separation are both improved by the reduction in layer thickness and particle size ]. Although HPTLC plates are significantly more expensive (4–6 times more expensive) than standard plates, they are an effective substitute when high levels of sensitivity, accuracy, and precision are needed in circumstances requiring high performance (9)

## Purification techniques

### Techniques for isolating and purifying phytoconstituents

The process of isolating the components of plant extracts or useful sections one at a time and purifying them into monomer compounds using physical and chemical processes is known as the separation of phytochemicals. Current isolation techniques still frequently include solvent extraction, precipitation, crystallisation, fractional distillation, salting out, and dialysis. The separation of phytochemicals, however, also benefits from the use of contemporary separation techniques such high performance liquid chromatography, ultrafiltration, and high performance liquid drop counter current chromatography. The common techniques and their unique applications for isolating phytochemicals are described in this section.



## **Solvent technique**

### **Method using basic solvent and acid**

It is done in accordance with the various levels of acidity and alkalinity present in each component of the mixture. Alkaline organic substances that are insoluble in water, like alkaloids, may react with inorganic acids to generate salts that can be used to distinguish nonalkaline and water-insoluble substances. Bases can salt acid components with carboxyl or phenolic hydroxyl groups and dissolve them in water. It is possible to saponify and dissolve in water components having lactone or lactam substructures before isolating them from other water-insoluble components. The entire extract can be split into acidic, alkaline, and neutral components by dissolving it in lipophilic organic solvents (ethyl acetate is frequently employed as a solvent) and extracting it with acid water and alkali water, respectively. Of course, after adjusting the pH, the entire extract can also be dissolved in water and extracted with organic solvents

The fractions can be further separated by using a pH gradient extraction due to differences in the alkalinity or acidity of the fractions. It is important to pay attention to the strength of the acidity or alkalinity, the contact time with the separated components, the heating temperature, and the time when using the acid and basic solvent method in order to prevent structural changes of some compounds under harsh conditions or the inability of the chemical structures to be returned to their original states.

### **Method for polarity gradient extraction**

Using this technique, the separation goal is accomplished based on the various polarities of the various plant extract constituents and the various partition coefficients in two-phase solvents. The polarity of the components in plant extracts is typically taken into account when choosing between different two-phase solvent systems. For instance, n-butanol and water can be used to separate components with strong polarity, ethyl acetate and water can be used to separate components with medium polarity, and chloroform (or ether) and water can be used to separate components with weak polarity.

### **Method of precipitation**

It is a technique that relies on the creation of some phytochemicals as precipitates through reactions with particular reagents, or the precipitation of some components from solutions through the addition of particular reagents, which can lessen the solubility of some components in solutions. If the target components are necessary for the formation of precipitation, the precipitation process must be reversible. The precipitation reaction can be irreversible if the components are nontarget since they will cause the precipitation to be eliminated. The following categories could be applied to this approach depending on the addition of chemicals or solvents: A specific solvent that is mutually soluble with the solution can be used to modify the constituents in the mixed component solution, allowing them to precipitate out of the solution. Fractional precipitation is the progressive precipitation caused by varying the polarity or amount of solvent supplied. For instance, ethanol is added to the water extracting concentrate to increase its alcohol content to more than 80%, which causes polysaccharides, proteins, starch, gum, and other substances to precipitate and be removed after filtration when using water as an extracting solvent to extract phytochemicals. The previous process is known as ethanol precipitation and water extraction. Using this technique, crude polysaccharides from plants are frequently separated.

## **Importance**

### **herbal formulation standardisation**

Application of Good Manufacturing Practices is required for standardising herbal formulation (GMP).

Additionally, it is deemed crucial to research a variety of parameters, including pharmacodynamics, pharmacokinetics, dose, stability, self-life, toxicity evaluation, and chemical profiling of herbal formulations. Aflatoxin level, heavy metal contamination, and Good Agricultural Practices (GAP) in herbal medication standardisation are a few additional factors that are equally important.

### **Uniformity in multi-herbal composition.**

As polyherbal formulations combine more than one herb to achieve the desired therapeutic effect, standardisation is crucial for maintaining and evaluating the product's quality and safety. Standardization reduces batch-to-batch variation and ensures the polyherbal formulations' acceptability, safety, efficacy, and quality. Madhumehari Churn (Baidynath): The Standardization of Various Marketed Herbal and Polyherbal Formulations (1)

### **Herbal crude drug standardisation and quality control –**

#### **Parameters**

Standardization and quality control of herbals, according to WHO (1996a and b, 1992), is the process involved in the physicochemical evaluation Of crude drug covering aspects, such as selection and handling of crude material, safety, efficacy, stability assessment of finished product, documentation of safety and risk based on experience, provision of product information to Consumer, and product promotion. Typically, attention is given to quality metrics like:(10)

#### **Morphology and organoleptic analysis:**

When evaluating a whole drug, morphological characteristics are crucial for differentiating it from other substances. It usually consists of things like colour, smell, taste, shape, and size. Details like as fractures, texture, and venation are included.

#### **Histological and microscopic analysis:**

These are beneficial in both whole and powdered form. It mainly involves the study of traits including stomata, fibres, calcium oxalate crystals, trichrome, parenchyma, and vascular bundle patterns.

Microscopically determined quantities include the number of vein islets, stomatal index, stomatal number, vein terminations, size of fibres, and palisade ratio. Such research aids in separating closely related species.

#### **Physical analysis**

physicochemical parameters such as moisture content, solubility, viscosity, refractive index, melting point, optical rotation, ash values, extractives, and foreign organic matter are studied.

#### **Quantitative chemical analysis:**

To determine the relative amounts of the main constituent classes.

### **toxicological research**

This aids in determining the presence or absence of potentially dangerous bacteria, pesticide residues, potentially poisonous elements, safety tests in animals like LD50, and microbial assays.

**microbial characteristics**

It contains the entire amount of viable, the entire mould count, and the entire coliforms count. Limiters are a quantitative or semi-quantitative tool that can be used to measure and limit the amount of impurities, such as solvents, reagents used in the extraction of various herbs, and contaminants that are sent directly from the production process.

**Quantitative chemical analysis:**

To determine the relative amounts of the main constituent classes.

**Convectional method:**

This entails identifying and classifying crude drugs according to their phytochemical components. In order to find and isolate the active ingredients, it uses various analytical techniques. Botanical identification, extraction using the right solvents, purification, and characterising the active components of pharmaceutical value are all part of phytochemical screening techniques. Issue with modern herbal technology Although herbal medicine has a very strong history of traditional applications and a global restructuring, there are still many obstacles to its promotion, particularly in wealthy countries. The following issues must be resolved before traditional herbal knowledge is promoted globally.

**Issues pertaining to quality control**

The biggest obstacles to maintaining the quality of herbal pharmaceuticals include standardisation, poor quality control practises, and a lack of Good Manufacturing Practices (GMP). In small and medium-sized companies, it is also common for farmers and manufacturers to be unaware of the guideline, and for the guideline to not be implemented or regulated.

**Organizational issues:**

Lack of effective monitoring and controlling, as well as a lack of regulatory and governing power in the herbal sector, are necessary necessities for the quality of medicines.

**a problem with the infrastructure**

The main issues are a lack of processing technology, trained personnel, advanced equipment, application of contemporary techniques, and local instrument fabrication facility.

**Pharmacovigilance:**

To identify toxicological information and adverse drug reactions of herbal medications, proper pharmacovigilance in the herbal sector is currently required. It's important to thoroughly monitor adverse responses, contraindications, combinations with other medications, foods, and traditional drugs.

**clinical experiment**

Clinical trials are required to establish the safety and efficacy of these treatments before introducing them in the worldwide market because safety is still a major concern when using herbal remedies.

**Biopiracy and IPR**

The main obstacle to the promotion of herbal traditional medicine is biopiracy. Thus, recording traditional knowledge is crucial for the future.

**Unreasonable use:**

It's a common misconception that herbal products have no adverse effects or interactions, but sadly this is untrue. Therefore, the inappropriate use of these pharmaceuticals can result in a number of issues that could impede their promotion.

## R&D:

The primary necessity for any drug is research and development on dose, processing, and procedures, although compared to allopathic medicine, it is far less in the herbal business.

For standardisation and quality control of herbal medicines, necessary selection criteria for compounds of herbal origin(11)

## Standardization and quality control of herbal resources, herbal preparations, and herbal medicines: general aspects

Herbal ingredients, herbal concoctions, and herbal products in their completed forms are highly complicated. This can make it exceedingly difficult to identify and quantify herbal medicines and make it very difficult to detect adulteration. It should be made clear that utilising markers to identify herbal medicines and measuring the amount of marker compounds present in herbal medicines do not, by themselves, ensure the quality of herbal medicines. Good agriculture and collection procedures (GACP) and good manufacturing practises (GMP) (such as those mentioned in references 1 and 4), when necessary, must be used in conjunction with quality control to cover all stages of production. the selection of reference materials and the control of quality criteria It is important to consider that different constituents in herbal medicines may have varying degrees of influence on their final quality, safety, and efficacy. This calls for the following principles to be followed when choosing the chemicals for identification and quantification.

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