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Advanced Herbal Technology

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Abstract: *The newest idea in herbal medication technology, known as the "herbosome," overcomes the drawbacks of conventional drug delivery methods. Since ancient times, doctors and patients around the world have used herbal medicines extensively due to their superior medicinal value. No negative effects or less side effects than contemporary medications. The herb's active components are bonded to phospholipids in the herbosome structures. A water-soluble head and two fat-soluble tails make up the phosphor lipid's molecular structure. The phosphor lipid works well as an emulsifier due to its dual solubility. The herb in some form provides drastically higher bioavailability for lipid soluble pharmaceuticals explained by faster and better absorption when the emulsifying properties of the phospholipids are combined with the standardised botanical extracts. digestion and intestinal absorption. Herbosome technology has been successfully used to increase the bioavailability of numerous well-known herbal extracts and phyto components, including ginseng, milk thistle, green tea, grape seed, and ginkgo biloba. It can also be produced for a variety of therapeutic uses or nutritional supplements. This approach has been deemed promising for efficient and appropriate systematic drug administration since it can increase the rate and amount of drug absorption through the lipoid bio-membrane.*

Keywords: Herbosome, Advanced technology, Herbal, Authentication, Isolation, Supercritical fluid

I. INTRODUCTION

The term "herbal" refers to a botanical or plant-based preparation, whereas "medicine" refers to a material that possesses nutritional, therapeutic, or preventative characteristics. As a result, substances made from plants that have nutritional, curative, or preventative characteristics are referred to as "herbal medicines." 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.

1.1 Different Methods of Identification of Plants

- Expert Determination: In terms of dependability or accuracy, expert determination is the best method of identification. Experts have typically created treatments (monographs, revisions, synopses) for the group in issue, and it's likely that the more recent floras or manuals include the ideas of taxa held by the expert. 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 reliability, it is comparable to expert judgement. This is based on the identifier's in-depth prior experience with the questioned plant group.
- Comparison: A third technique involves comparing an unknown with 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.
- Using Keys and Other Comparable Instruments (Synopses, Outlines, etc.) This approach is by far the most popular and doesn't require the resources, effort, or expertise that other approaches do.

1.2 Authentication of Plants

Herb authentication is a quality control procedure that makes sure the right kinds of plants and plant components are utilised as the foundation for herbal medications. Authenticating raw herbal products properly

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- Materials have a crucial role in the safety and effectiveness of herbal medications.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.
- 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 (hair), the placement of stomata in the epidermis, the presence or lack of substances like mucilage, starch, or lignin, or the presence of tissues with certain cell types may all be used to identify herbal medications under the microscope.
- The separation of chemical components in a mixture is called chromatography. There are numerous techniques, but they are all founded on the same fundamental ideas. The majority of herb monographs 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. Another type of chromatography that is frequently employed in the identification and examination of herbal compounds is high-performance liquid chromatography (HPLC). Gas chromatography is yet another form that is utilised in particular for fatty acids and essential oils.

1.3 Different Extraction Methods

A. Supercritical Fluid 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

Solvent Extraction= also known as liquid-liquid extraction and partitioning, is a Method to separate compounds based on their relative solubility in two different Immiscible liquids, usually water and an organic solvent.

It involves transferring a material from one liquid phase to another.

It is carried out using a separatory funnel in chemical laboratories as a fundamental technique. In other terms, this is the preferred dissolution of a substance in a suitable solvent in order to separate it from a mixture.

Analytically, solvent extraction can be used to concentrate or reject a specific chemical or to separate mixtures.

This procedure often distinguishes between soluble and insoluble compounds. The processing of ore, the creation of fine organic compounds, the production of perfumes, and other sectors all require solvent extraction.

Supercritical Fluid Extraction=Separation of the analyte or analytes from a sample matrix is frequently necessary as a first step in the analysis of complicated materials. An analytical separation method should ideally be quick, easy, and affordable; it should provide quantitative recovery of analytes without loss or degradation; it should produce an analyte solution that is sufficiently concentrated to allow for final measurement without additional concentration; and it should produce little to no waste that needs to be disposed of.

This procedure often distinguishes between soluble and insoluble compounds. The processing of ore, the creation of fine organic compounds, the production of perfumes, and other sectors all require solvent extraction.

For a long time, one of the most popular techniques for carrying out analytical separations on challenging environmental, pharmaceutical, food, and petroleum samples was based on the extraction of bulk samples using a Soxhlet extractor and hydrocarbon or chlorinated organic solvents. Sadly, lli typically falls short of a number of the desirable standards.

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Supercritical Fluid

Any substance above its critical Point at a temperature and pressure is considered a supercritical fluid. It has the ability to dissolve substances like a liquid and diffuse through solids like a gas. Additionally, a supercritical fluid's various properties can be "fine-tuned" close to the critical point since slight changes in temperature or pressure cause large changes in density.

In a variety of industrial and laboratory operations, supercritical fluids can replace organic solvents.

The most popular Supercritical fluids are carbon dioxide and water, which are utilised for power production and decaffeination, respectively.

CO2 is a type of solvent used for plant extraction. There are no harmful remnants left behind. With small adjustments in temperature and pressure, its extraction properties can be controlled broadly and precisely.

1.4 Microwave Assisted Extraction

The fundamentals of microwave-aided extraction.

Microwaves are a subset of the electromagnetic spectrum of light, with frequencies ranging from 300 MHz to 300 GHz and wavelengths between 1 cm and 1 m. (Mandal et al., 2007). Two parallel oscillating fields that make up these waves serve as energy and information carriers. The first use of microwaves is their interaction with particular materials that can absorb some of their electromagnetic energy and transform it into heat. For this purpose, commercial microwaves use 2450 MHz of energy, which is about comparable to 600–700W.

1.5Ultrasound Assisted Extract

The usage of ultrasound extraction dates back at least to the discovery of fire.

Innovative extraction and distillation techniques were utilised even for food, cosmetics, and perfumes by Egyptians, Phoenicians, Jews, Arabs, Indians, Chinese, Greeks, and Romans. Nowadays, extraction procedures like maceration, solvent extraction, steam or hydro distillation, cold pressing, and squeezing are used on every manufacturing line in the food, pharmaceutical, cosmetic, nutraceutical, and bioenergy industries.

The food and plant-based chemical industries are challenged to develop new technologies in order to meet legal requirements for emissions, product/process safety and control, cost reduction, and improved quality. This is because energy costs are rising and there is a push to reduce greenhouse gas emissions.

Existing extraction systems, for instance, have significant scientific and technological challenges: frequently requiring more than 50% of the investment in a new plant and

The food industry uses 70% of all process energy [1].

Due to these flaws, improved and effective extraction methods that can be automated, including ultrasound-assisted extraction, have been taken into account over the past 20 years.

The primary goals were to reduce organic solvent usage, increase extraction times, and save money and energy.

Advances in ultrasound-assisted extraction have been driven by these objectives, leading to a number of cutting-edge methods including ultrasound-assisted Soxhlet extraction, ultrasound-assisted Clevenger distillation, continuous ultrasound-assisted extraction, and ultrasound-assisted extraction in combination with microwave, extrusion, and supercritical fluid extraction.

1.6 Isolation and Purification Technique

1. Standard isolation methods
2. Methods of extraction
3. The separation of natural plant components and their purification depend on the extraction of plant material.
4. Plant matrices naturally contain a variety of chemicals with different physical.
5. Chemical properties, making them complicated in nature.
6. Therefore, it is essential to thoroughly separate plant matrices from the rest of the organism and generate pure molecules that are of interest to plants in order to characterise them. There are numerous extraction techniques.
7. is classifiable . They have been grouped in this chapter according to the temperatures they operate in.
8. Methods for Low or Room Temperature

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9. The cold extraction technique
10. The procedure has been written about in the literature. Samples of dried plant components that have been cut, crushed, or milled Extraction strategies

The separation of natural plant components and their purification involve the extraction of plant material.
Plant matrices are naturally complicated because they contain a variety of substances with unique physical and chemical characteristics.
Therefore, it is essential to thoroughly separate the matrixes of interest in plants from the rest of the plant in order to generate pure molecules for their characterisation. There are numerous categories into which extraction procedures might be put. They have been divided into groups in this chapter according to the temperatures they operate in.

II. METHODS FOR LOW OR ROOM TEMPERATURE

The method has been written about in books. In a nutshell, dried plant component samples are placed in various solvents for seven days while being shaken every day.
24 hours. The samples are next processed through a Whatman filter paper, dried under vacuum at room temperature on pre-weighed watch glasses, and the mass of yield is calculated based on the difference.
Maceration is a typical instance of cold extraction. Using this technique, a coarsely ground plant
Plant material, whether in part or whole, is shaken often while being stored for a while in contact with a solvent.
This causes the solvent-dissolved soluble material to be released [12]. Low temperature extraction techniques have the benefit of being straightforward, affordable, ecologically friendly [6], and practicable even in the field. Their drawback is that they might not be able to extract all of the chemicals from the plant matrix.
Enzyme Assisted Extraction (EAE): This technique uses solvents along with a variety of enzymes that are chosen based on the conditions in which they function best and the pathway that the researcher desires the substances to be catalysed. Protease, lipase, and phospholipase are a few of the enzymes frequently utilised in extraction, and they significantly cut down on the need for solvents [13]. Pectinase and -amylase are the enzymes that are frequently employed with essential oils. Although the setup is expensive, the process does not degrade compounds. In terms of necessary nutrition, oxygen levels, and temperature optimization matrices, it is also excessively demanding.

2.1 Method of High-Temperature Extraction

Compounds that are known to be thermally stable should be extracted at high temperatures [16, 17]. Although many people worry that extraction at high temperatures will destroy important chemicals, this is not always the case. An investigation into the phenolic components and antioxidant properties of Asiaticacantella following extraction at 90°C was conducted [18]. Therefore, it is crucial to comprehend the makeup of the relevant chemicals found in plant materials.

Decrepitude

This procedure requires 15 minutes of boiling in water, cooling, filtering, and adding the correct volume of cold water to the medication. This technique can be used to extract chemicals of interest from herbal plants that are heat stable and soluble in water
[17]Due to the high temperatures used, this process produces more oil-soluble chemicals than infusion and maceration.
[18]According to reports that some herbalists utilise it, this technique is inexpensive and easy to put up.

Soxhlet Extraction

This works best when the compounds of interest are known to only be partially soluble in the solvent and when the solvent's impurities are insoluble. Thermolabile chemicals are not transported using this method since it may cause their degradation. This method's advantage is that it only needs one hot solvent pass because the same is recycled, as opposed to many passes [16]. It needs a lab setup and Soxhlet equipment.

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III. CHROMATOGRAPHIC TECHNIQUE INTRODUCTION

Introduction

Since prehistoric times, people have used hundreds to thousands of native plants to treat illnesses on all continents. Many plants produce chemicals that are important for maintaining human and animal health. Among them are aromatic compounds, the majority of which are phenols or their oxygen-substituted derived substances, such tannins

1. Animals in distress frequently consume plants high in secondary metabolites, such as alkaloids and tannins. It is conceivable that wild animals self-medicate because these phytochemicals frequently have antiviral, antibacterial, antifungal, and anthelminthic effects.
2. Around 80% of people worldwide still utilise herbs and other traditional medicines for their main healthcare requirements, according to a World Health Organization (WHO) estimate. Health-improving dietary supplements known as herbal medicine are available as tablets, capsules, powders, teas, extracts, and fresh or dried plants. Herbs are generally thought to be safe, and more individuals are consuming them without a prescription. Chromatography with one thin layer

Simple abbreviation for thin layer chromatography is TLC. It is one of the most widely used and straightforward chromatographic techniques for chemical separation TLC is often used in the phytochemical evaluation of herbal medicines for the following reasons:

1. It has two main benefits:
2. It permits quick analysis of herbal extracts with little cleanup of the sample.
3. It offers qualitative and semi-quantitative data on the resolved components.
4. It possible to quantify chemical components. In some circumstances, fingerprinting using HPLC and GLC is also done.

The information that can be captured using a high performance TLC (HPTLC) scanner for TLC fingerprinting includes the chromatogram, retardation factor (R f) values, colour of the separated bands, their absorption spectra, and the maximum and shoulder inflections of all resolved bands.

All of them depict the sample's TLC fingerprint profile, along with the profiles on derivatization with various reagents.

The data produced in this way may be used to identify genuine pharmaceutical products, weed out adulterants, and preserve the drug's potency and consistency. Prior to the development of instrumental chromatography techniques like GC and HPLC, TLC was the method of choice for herbal examination. Since many pharmacopoeias still use TLC to provide the first distinctive fingerprints of herbs, including the American Herbal Pharmacopoeia (AHP), Chinese drug monographs and analyses, and Pharmacopoeia of the People's Republic of China, it is still widely used for the analysis of herbal medicines today. TLC is instead employed as a quicker way of first screening with a semi-quantitative assessment and additional

IV. COLUMN CHROMATOGRAPHY

In chemistry, a single chemical compound can be isolated from a mixture using a technique called column chromatography.

Due to the fact that different chemicals bind to the adsorbent differently and pass through the column at various speeds, chromatography can divide substances into fractions.

The method can be employed with a wide variety of adsorbents (normal phase, reversed phase, or other) and solvents, making it widely adaptable. The method is applicable at scales ranging from micrograms to kg.

The fundamental benefit of column chromatography is the stationary phase, which is inexpensive and easily disposed of after usage.

The latter stops recycling-induced stationary phase deterioration and cross-contamination. Both gravity and compressed gas can be used in column chromatography to force the solvent through the column. Chromatography using High Performance Thin Layers (HPTLC)

High Performance Thin Layer Chromatography (HPTLC)

The pharmaceutical sector uses the HPTLC technique frequently for process development, adulterant detection in herbal products, pesticide content determination, mycotoxin determination, and quality control of medicinal plants and

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foods. Multiple samples can be run simultaneously by using a lesser amount of mobile phase than in HPLC, as has been widely documented. Additionally, mobile phases with a pH of 8 or higher may be employed for HPTLC.

The repeated detection (scanning) of the chromatogram under the same or different circumstances is another benefit of HPTLC. In order to simultaneously test many components in a multi component formulation, HPTLC has been researched.

This method makes it possible to verify the authenticity of different plant species and to assess the stability and consistency of their preparations from diverse manufacturers.

For phyto components found in unprocessed medications or herbal preparations like bergenin, catechine, and gallic acid in Bergeniacilliata and Bergenialingulata, many researchers have developed HPTLC methods.

Table 2: Example of mobile phase used in HPTLC for herbal compound

The analysis of herbal remedies has seen the most extensive use of HPLC in recent years.

The most common columns employed in the analytical separation of herbal medicines are likely reversed phase (RP) columns.

For isolating and purifying herbal components, pharmaceutical companies frequently utilise preparative and analytical HPLC.

Preparative HPLC can be divided into two categories: low pressure HPLC (usually under 5 bar) and high pressure HPLC (pressure greater than 20 bar).

In analytical HPLC, the crucial factors to be taken into account are resolution, sensitivity, and quick analysis times, whereas in preparative HPLC, the crucial factors to be taken into account are throughput or recovery, as well as the level of solute purity and the amount of compound that can be produced per unit time.

Larger stainless steel columns and packing materials (particle size 1030 m) are required for preparative HPLC (pressure >20 bar).

Examples of silica columns in normal phase include Kromasil 10 m, Kromasil 16 m, and Chiralcel AS 20 m, while those in reverse phase include Chromasil C18, Chromasil C8, and YMC C18.

Compounds are to be isolated or purified, but in analytical work, information about the sample is what is sought after.

This is crucial in the modern pharmaceutical sector because new products—natural and synthetic— must be released onto the market as soon as feasible.

Being able to use such an effective purification method reduces the amount of time needed for the synthesis conditions.

Extremely effective liquid chromatography (HPLC)

The distribution of the analyte (sample) between a mobile phase (eluent) and a stationary phase is the foundation of the HPLC separation principle (packing material of the column). The molecules travel through the stationary phase more slowly depending on the chemical makeup of the analyte. The duration of a sample's "on-column" time is determined by the specific intermolecular interactions between the sample's molecules and the packing material.

As a result, different components of a sample elute at various periods.

Thus, the sample ingredients are successfully separated. After leaving the column, the analytes are recognised by a detecting equipment (such a UV detector). A data management system (computer software) converts and records the signals, which are subsequently shown in a chromatogram. The mobile phase may then be subjected to further detector units, a fraction collecting unit, or the waste after passing the detection unit.

A solvent reservoir, a pump, an injection valve, a column, a detector unit, and a data processing unit are the typical components of an HPLC system.

The pump circulates the solvent (eluent) throughout the system at a high pressure and steady speed. A continuous and pulseless flow from the pump is essential to minimise the drift and noise of the detector signal.

The injection valve delivers the analyte (sample) to the eluent.

Purification techniques for isolated phytoconstituents

The process of isolating the components of plant extracts or useful parts one at a time and purifying them into monomer compounds using physical and chemical means is known as the separation of phytochemicals. Current isolation techniques still frequently include solvent extraction, precipitation, crystallisation, fractional distillation, salting out, and dialysis.

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separation of phytochemicals also benefits from the use of contemporary separation techniques including high performance liquid chromatography, ultra filtering, and high performance liquid drop countercurrent chromatography.

The common techniques and their unique applications for isolating phytochemicals are described in this section. S 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 combine with inorganic acids to generate salts that can be used to separate them from non-alkaline 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.

The strength of the acidity or alkalinity, the contact time with the separated components, the heating temperature, and the time should all be taken into consideration when using the acid and basic solvent method in order to avoid some compounds' structural changes under harsh conditions or the chemical structures' inability to change.There is no way to restore structures to their original states.

Method for polarity gradient extraction With 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.

The plant extract must first be dissolved in water throughout the procedure, after which the solution or suspension is extracted in a separating funnel using a separate organic solvent that is incompatible with water due to polarity differences.

As illustrated in Figure 1, the extract was typically extracted using petroleum ether (or cyclohexane) first, followed by ethyl acetate (or chloroform), and then water-saturated n-butanol. Low polarity, lipid-soluble molecules can be found in the petroleum ether layer.

Medium polar substances including monoglycosides, flavonoids, and substances with more polar functional groups are present in the ethyl acetate layer.

Strongly polar substances like oligoglycosides and other water-soluble components can be found in the N-butanol layer.

strongest polarity is seen in chemicals in the water layer, including glycosides with more

glycosyl groups, carbohydrates, amino acids, proteins, and other water soluble substances.

The precipitation approach is based on the creation of some phytochemicals as precipitates through reactions with specific reagents, or the precipitation of some components from solutions with the addition of specific reagents that 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 non-target since the precipitation that is created will 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.

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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 plant polysaccharides are frequently separated.

V. INTRODUCTION TO DIFFERENT TECHNIQUE OF CHARACTERIZATION OF BIO ACTIVE CONSTITUENTS

5.1 Introduction

The right extraction technique is crucial for qualitative and quantitative research of bioactive chemicals from plant materials (Smith, 2003, Sasidharan et al., 2011). The initial step in every study of a medicinal plant is extraction, which has a substantial impact on the outcome. "Sample preparation techniques" are another name for extraction methods. The majority of the time, this aspect of the study is disregarded and carried out by untrained research staff (Hennion et al., 1998), despite the fact that sample preparation techniques take up about two thirds of an analytical chemist's work. According to Majors' (1999) survey, the majority of researchers think sample preparation is crucial for any analytical study.

The success of bioactive compound analysis still depends on the extraction procedures, input parameters, and precise nature of plant parts. It is true that development of contemporary chromatographic and spectrometric techniques has made the process easier than in the past (Poole et al., 1990). The matrix qualities of the plant portion, the solvent, the temperature, the pressure, and the duration are the most frequent variables influencing the extraction process (Hernández et al., 2009).Bioactive substances typically coexist with other substances found in plants.

Different plant components, including leaves, stems, flowers, and fruits, can be used to identify and characterise bioactive chemicals.

Different extraction techniques can be used to extract plant components. Over the past 50 years, novel techniques have been created that are more environmentally friendly because they utilise fewer synthetic and organic chemicals, operate more quickly, and provide extracts of higher yield and quality. In order to increase overall yield and selectivity of bioactive components from plant materials, various techniques have been used, including ultrasound (Vinatoru et al., 1997; Ghafoor et al., 2011); pulsed electric field (Toepfl et al., 2006); enzyme digestion (Gaur et al., 2007); extrusion (Lusas and Watkins, 1988); microwave heating (Kaufmann and Christen, 2002); ohmicheatingStudies on unconventional techniques (Kaufmann and Christen, 2002; Smith, 2002) have been conducted.

Traditional extraction techniques like Soxhlet are still used as a benchmark when evaluating the efficacy of newly developed methodologies. There are numerous scientific studies, book chapters, and monographs (Jennings and Rapp, 1983; Moldoveanu and David, 2002; Szumski and Buszewski, 2002; Majors, 2003; Smith, 2003; Wang and Weller, 2006) where non-conventional methodologies have been thoroughly examined. These works emphasise the application of extraction techniques for nutraceuticals, food additives, and many other industries, but they do not discuss the extraction of bioactive chemicals from herbal plants. The goal of the current research is to give a thorough analysis of several methods for extracting bioactive substances from medicinal plants.

Conventional extraction techniques

Various traditional extraction procedures can be used to extract bioactive chemicals from plant sources. The majority of these methods rely on the ability of various solvents to extract materials while also applying heat and/or mixing. The three traditional methods that are now in use to extract bioactive components from plants are: (1) Soxhlet extraction (2) Maceration and (3) Hydro distillation.

Franz Ritter Von Soxhlet, a German scientist, was the one who first proposed the Soxhlet extractor (1879).

Non-Conventional Extraction Techniques

Longer extraction times, the need for expensive, high-purity solvents, the evaporation of enormous amounts of solvent, low extraction selectivity, and the heat breakdown of thermo-labile chemicals are the main drawbacks of conventional extraction (Luque de Castro and Garcia-Ayuso, 1998). New and promising extraction approaches are offered to address

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these limitations of traditional extraction methods. These methods are known as non-traditional extraction methods. among the most

Methods for Standardization of Herbal Drugs

Importance of Standardization

Herbal Formulation Standardization

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. Aflatoxine level, heavy metal contamination, and Good Agricultural Practices (GAP) in herbal medication standardisation are a few additional factors that are equally important.

Polyherbal Formula Standardization

Standardization is crucial for preserving and evaluating the efficacy and safety of poly herbal formulations, which combine several herbs to produce the desired therapeutic effect. Standardization reduces batch-to-batch variation and ensures the poly herbal formulations' safety, efficacy, purity, and acceptability. since these are mixtures of multiple herbs to get the desired therapeutic effect. Standardization reduces batch-to-batch variation and ensures the poly herbal formulations' safety, efficacy, purity, and acceptability. The standardisation of several commercialised herbal and polyherbal Madhumehari Churna (Baidynath) formulations, which feature a blend of eight herbs. A traditional remedy called dashamularishta is used to restore physiological processes to normality following childbirth. The identity, purity, and potency of the polyherbal formulation, as well as setting standards for this Ayurvedic formulation, were determined using TLC and HPTLC fingerprint profiles.

Herbal Crude Drugs: Standardization andQuality 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, and 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:

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. Detail Fractures, texture, venation, and other characteristics are among them.

Histological and microscopic analysis: These are beneficial in both whole and powdered form. It focuses mostly on the examination of traits including trichomes, calcium oxalate crystals, vascular bundle patterns, stomata, fibres, and parenchyma.

microscopic measurements such as fibre size, palisade ratio, stomatal index, stomatal number, and vein termination number. Such research aids in separating closely related species.

Physical evaluation involves the examination of a number of physical parameters, including moisture content, solubility, viscosity, refractive index, melting point, optical rotation, ash values, extractives, and foreign organic matter. fibre size and palisade ratio Such research aids in separating closely related species.

Physical evaluation involves the examination of a number of physical factors, such as moisture content, solubility, viscosity, refractive index, melting point, optical rotation, ash values, extractives, and foreign organic matter.

Analyzing chemicals qualitatively entails identifying and classifying raw drugs according to their phytochemical components. It uses various analytical methods to find and isolate the active ingredients. The purification, characterisation, and use of appropriate solvents in botanical preparations are all aspects of phytochemical screening approaches.

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Quantitative Chemical Evaluation

To calculate the volume of the main constituent classes. Toxicological studies: These serve to identify pesticide residues, possibly toxic substances, safety tests in animals such the LD50, and microbial assays to assess whether potentially harmful bacteria are present or absent.

Microbiological parameters: These include the total count of coliforms, mould, and live bacteria. 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 impurities shipped directly from the factory.

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.

The identification of plants, their extraction using the right solvents, purification, and characterization of the pharmaceutically significant active ingredients are all steps in the phytochemical screening process.

Quantitative Chemical Analysis

To calculate the quantities of the main constituent classes.

Studies on toxicology: These aid in identifying pesticide residues, potentially hazardous substances, safety tests on animals such the LD50, and microbial assays to establish the presence or absence of potentially harmful microorganisms.

Microbiological Parameters

These include the total count of coliforms, mould, and live bacteria. 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 different herbs, and contaminants that are shipped directly from the production process. 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. Before promoting traditional herbal knowledge globally, the issues listed below must be resolved., extraction.

Quality issues:

The main issues that diminish the effectiveness of herbal preparations and can be regarded as important variables impacting the quality and purity of herbal medicines include adulteration, misidentification of plants, poor collecting and preparation, and inappropriate formulation processes. Problems in harvesting and processing: Inadequate pre and post harvest processes, indiscriminate harvesting, poor agriculture and propagation methods, and a lack of processing techniques all contribute to the inferior quality of herbal medications. 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.

Administrative 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. Infrastructure-related problem: The main issues are a lack of processing skills, skilled workers, advanced equipment, the use of contemporary procedures, and local instrument fabrication facilities. Pharmacovigilance

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

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Clinical trial: Because the safety of using herbal remedies continues to be a major concern, clinical trials are required to determine the safety and effectiveness of these medications before introducing them to the worldwide market. Biopiracy and IPR:

The main obstacle to the advancement of herbal traditional medicine is bio piracy. 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: Research and development on dose, processing, and procedures is essential for any drug, but it is significantly less common in the herbal business than it is in allopathic medicine. Nevertheless, the tendency has changed in recent years. Research is required to comprehend the mode of action and pharmacokinetics phenomena, as well as to improve/create monographs and reference standards for marker-based analysis. Another issue for a sustainable, socio-culturally equitable, and safe supply of herbal medicines is the significant gap between current ethnopharmacological and modern medicinal plant research.

Additional obstacles: unethical use of herbal medicine, a shortage of qualified medical professionals, the dissemination of inaccurate and misleading information, a lack of funding, a lack of targeted marketing and branding, and a lack of knowledge exchange. Another significant issue is the lack of protection for biodiversity and traditional medicinal plants.

WHO guidelines for quality standardized herbal formulation

1. Control of the quality of raw drug ingredients, plant preparations, and final goods.
2. Evaluation of stability and shelf life
3. Safety evaluation; documentation of safety based on practical knowledge or toxicological research.
4. Evaluations of biological activity and ethno-medical data are used to determine effectiveness.

The chromatographic fingerprints and active principles or main chemicals should be used to standardise the bioactive extract (TLC, HPTLC, HPLC, and GC).

In general, all medications should meet the fundamental condition of being both safe and effective, regardless of whether they are made of synthetic materials or plants. 28 29. The term "herbal medications" refers to plants or plant components that have been processed into phytopharmaceuticals using straightforward harvesting, drying, and storage procedures. 30.

Herbal Drug Quality Control

The phrase "quality control" describes procedures used to preserve a manufactured good's quality and validity. Three crucial pharmacopeial factors serve as the foundation for quality control generally.

1. Identity or authenticity: It ought to include just one plant
2. Purity: It should only include herb and not any other contaminants.
3. The active ingredients should be within the specified limits. c. Assay or Content By doing macroand microscopical exams, identity can be determined. In addition to these identity checks, chromatographic testing and simple chemical tests like colour or precipitation are also required.
4. The chromatogram can be used as a "fingerprint" for the herbal ingredient by displaying the profile of several common plant compounds like flavonoids, alkaloids, and terpenes. These chemical and chromatographic tests aid in batch to batch comparability. Criteria such preparation method, sensory characteristics, physical constants, adulteration, impurities, moisture content, ash content, and solvent residues must be examined in order to demonstrate identity and purity.Voucher specimens make for trustworthy reference materials. Plant disease outbreaks may alter the morphological characteristics of the plant, making it difficult to identify it. 32 Purity, which deals with elements like ash values, contaminants (such as foreign matter in the form of other herbs), and heavy metals, is intimately related to the safe use of medications. However, due to the use of more advanced analytical techniques, modern purity evaluation also takes into account pesticide residues,

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radioactivity, and aflatoxins.To determine the consistent composition of herbal remedies, analytical techniques include photometric analysis, Thin layer chromatography (TLC), High performance liquid chromatography (HPLC), High performance thin layer chromatography (HPTLC), and Gas chromatography (GC) can be used. In order to develop pertinent criteria for uniformity, various concepts, such as "normalisation vs standardisation," must be utilised depending on whether the active principles of the preparation are known or unknown. Since the active ingredients in the majority of herbal medications are unknown, content or assay is the most challenging area of quality control to execute.Markers may occasionally be utilised. In all other circumstances, the proportion of extractable substance using a solvent may be utilised as a form of test, a method that is frequently found in pharmacopeia33–34, where no active ingredients or markers can be established for the herbal drug. The determination of essential oils by steam distillation is a unique type of assay. A wide range of contemporary chemical analytical techniques, such as ultraviolet/visible spectroscopy(UV/VIS), TLC, HPLC, HPTLC, GC, mass spectrometry, or a combination of GC and MS(GC/MS), can be used35 when active constituents (for example, sennosides in senna) or markers (for example, alkydamides in Echinacea) are known.

Stability Assessment And Shelf Life

Long-term, seemingly uneventful usage of a substance typically attests to its safety. The investigation of the potential toxicity of naturally occurring substances that are frequently used as ingredients in these preparations, however, has occasionally revealed previously undetected potential for systematic toxicity, carcinogenicity, andtion of parameter limits used for standardisation teratogenicity. These discoveries must be accurately and promptly reported to the regulatory authorities.

They should also have the power to act in response to such signals, such as by revoking or changing the licences of registered items that include questionable ingredients or by rescheduling the chemicals to restrict their usage to prescription medicines.

Evaluation of the quality

Good manufacturing practises should be followed throughout the entire process.

Unclean Plant Materials

The botanical definition should include the genus, species, and authority, as well as a description of the plant's parts and its active and distinguishing elements. If at all possible, content restrictions should also be indicated.

It is important to establish or set a limit on foreign matter, impurities, and microbiological content. Voucher specimens for each item of processed plant material should be authenticated by a certified botanist and kept for at least ten years. The product label should include the lot number that has been assigned.

Prepared Plants

The production process needs to be thoroughly explained. Other compounds should be stated in the production methods if they are added during manufacture to change the plant preparation to a specific level of active or distinctive ingredients or for any other reason. It should also include a procedure for identifying the plant preparation and, if practical, for assaying it. It should be sufficient to identify a distinctive component or combination of compounds to assure consistent quality of the preparation if identification of an active principle is not achievable.

Finished Parts

There needs to be a full explanation of the production process. If additional substances are introduced during manufacturing to alter the plant preparation to a particular amount of active or unique components, or for any other purpose, they should be disclosed in the production processes. A method for recognising the plant preparation and, if possible, assaying it should also be included. If the identification of an active principle is not possible, it should be sufficient to identify a distinctive component or combination of compounds to ensure consistent quality of the preparation.

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Stability

Under specific storage conditions, the product's physical and chemical stability in the container in which it is to be marketed should be evaluated, and the shelf life should be determined.

Safety Assessment

In general, herbal medications are viewed as safe due to their lengthy history of use in a variety of cultures.

Serious adverse outcomes following the intake of herbal products have, nevertheless, been documented in case reports. The toxicity has frequently been linked to impurities and adulteration. Some of the plants utilised in herbal remedies can, however, also be quite hazardous. If not carefully analysed, herbal medications could potentially result in negative side effects, drug-drug and drug food interactions.

Therefore, the top priority in herbal research is to evaluate the safety of herbal products. These are different methods for assessing the safety of herbal medications. The following factors are mostly responsible for the harmful effects of herbal preparations: inherent toxicity of plant components, contamination during manufacturing, and manufacturing malpractice. In-depth phyto-chemical and pharmacological research are necessary to evaluate the harmful effects of plant components in herbal formulations. However, it is safe to infer that the usage of hazardous plant compounds has already been substantially abolished based on human experiences in diverse cultures, and that current claims of toxicity may mostly be caused by misidentification and overdose of particular constituents36. Another significant problem is the adulteration of botanical preparations. Numerous medicinal plants have become rare or endangered species status as a result of overuse of some plants, habitat degradation, and forest fragmentation.These and numerous other factors (such as the price of raw materials) make it difficult to find genuine medications, which encourages the adulteration of plants by using subpar commercial varieties, artificially created substances, outdated medications, less expensive plants, or other vegetative parts37. Many herbal items may include hidden medications and toxic metals, according to several reports38. It is possible to utilise medicinal adulterants on purpose. To shield the plant from the unprocessed plant matter, agrochemicals are applied. Furthermore, research on the pharmacokinetics, drug-drug interactions, and mechanism of action of many herbs is still in its infancy.The demand for national regulation, registration, and safety monitoring of herbal medicines is intensified at the same time by an increase in reports regarding the fatal or severe consequences of herbal preparations. Clinicians shouldn't prescribe or suggest herbal therapies that aren't well-established as being effective as drugs based on extensive research39.

Assessment of Toxicity

Because the analysis alone is unlikely to identify the contributions to toxicity itself, toxicity investigation will also be necessary. The dose selected is crucial in determining a herbal medicine's toxicity40. One or more of the following approaches are used in toxicity assessment: in vitro, in vivo, cell line, micro-array, and other contemporary techniques, standardisation, and techniques to accurately represent toxicity.

Assessment of Efficacy

Although standard clinical trial approaches are currently being utilised to evaluate medicines, which are essentially different from conventional pharmacological therapies in that their efficacy is typically measured by clinical, laboratory, or diagnostic outcomes: Clinical outcomes can be measured in terms of characteristics including decreased morbidity, decreased pain or discomfort, increased appetite and weight gain, decreased blood pressure, decreased tumour size or extent, and increased quality of life. Laboratory and other diagnostic outcomes can be quantified in terms of things like decreased blood sugar levels, improved haemoglobin levels, decreased opacity as determined by imaging or radiographic methods, and improved electrocardiogram (ECG) results. The adoption of a standardised procedure for herbalists and the gathering of prospective data inevitably result in an interventional design that, with careful planning, may closely mimic singleblindrandomised trials. Even though it is less rigorous than double-blind randomised trials, the design can be the best option medically and financially for a quick assessment of herbal products. However, there are situations where standardisation may not be compatible with the current legal system, and care must be taken while considering the ethical implications of such investigations. Although it can be challenging to execute randomised clinical studies—with double blind trials serving as the gold standard—in the context of herbal medicine, they are not

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entirely disregarded when determining the effectiveness of these items. Data from case series investigations may provide sufficient scientific and ethical validity to carry out such trials, but adoption of this methodology necessitates a paradigm shift in the way conventional medicine approaches the process of drug review.

Herbal medication standardisation and quality control entail a wide range of scientific investigations, including physical, chemical, and biological evaluation using a variety of analytical techniques and equipment.

Physical Evaluation

Each monograph includes thorough botanical, macroscopic, and microscopic descriptions along with thorough illustrations and photographs that offer visual proof of correctly identified material. A microscopic examination confirms the authenticity of the substance and serves as a preliminary check for contaminants.

Chemical Evaluation

To determine the strength of vegetable material in terms of its active ingredients, a chemical analysis of the medication is conducted. It addresses the purification, isolation, identification, and screening of the chemical constituents. It aids in identifying the drug substance and any potential adulteration.

Biological Evaluation

The pharmacological activity of some medications has been used to standardise and evaluate them. The effectiveness of the medicine or its preparations can be determined by assays on living creatures and on their intact or isolated organs.

Analytical Methods

Identification, quality, and relative potency are all aided by it. The preparation of samples is the most crucial phase in the development of analytical techniques for botanical and herbal preparations. The fundamental procedure entails actions like pre-washing, drying of plant materials or freeze drying, and grinding, to generate a homogeneous sample and frequently improve the kinetics of constituent extraction. Methods like sonication, heating under reflux, Soxhlet extraction, and others are frequently used in the pharmacopoeial monographs4142 But these techniques could be timeconsuming, utilise a lot of organic solvent, and have inferior extraction efficiency.Ongoing research is being done to find new solutions to this problem. Target molecules could be polar, nonpolar, or even thermally labile, therefore the compatibility of the extraction techniques must be taken into account. Newer sample preparation techniques, such as microwave-assisted extraction (MAE), supercritical fluid extraction (SFE), accelerated solvent extraction (ASE), and pressurised liquid extraction (PLE), have been introduced for the extraction of targeted constituents present in plant materials in an effort to decrease or completely eliminate the use of organic solvents and improve the extraction processes.

Chromatography

The essential stage to permit identification and bioactivity evaluation is the separation of individual components from the herbal mixture. Chromatography is a potent analytical technique that may be used to separate and quantify a large number of chemicals, even from a complicated matrix.These include capillary electrophoresis, gas chromatography, thin-layer chromatography, high-performance liquid chromatography, and paper chromatography (PC) (CE). Because it enables quick analysis of herbal extracts with little sample cleanup needed and because it offers qualitative and semiquantitative information about the resolved chemicals, TLC is widely employed in the phytochemical evaluation of herbal drugs. The chromatogram, retardation factor (Rf) values, colour of the separated bands, their absorption spectra, and max and shoulder inflection/s of all the resolved bands are among the data that may be recorded using a high performance TLC (HPTLC) scanner in TLC fingerprinting. All of them depict the sample's TLC fingerprint profile, along with the profiles on derivatization with various reagents.Chromatograms, peak retention times, and absorption spectra (recorded with a photodiode array detector) are all recorded as part of HPLC fingerprinting using various mobile phases.

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Parameter limit used for standardization

Physical, chemical, and microbiological factors make up the stability parameters for herbal preparations.

Physical characteristics include viscosity, moisture content, pH, disintegration time, friability, hardness, flow ability, flocculation, sedimentation, settling rate, and ash values. Other characteristics include colour, appearance, odour, and clarity.

Chemical parameters include assays, extractive values, and limit tests, among others.

Herbals can be analysed chromatographically using TLC, HPLC, HPTLC, GC, UV, fluorimetry, GCMS, and other techniques.

Microbiological parameters include total viable content, total mold count, total enterobacterial and their count. Limiters can be utilized as a quantitative or semi quantitative tool to ascertain and control the amount of impurities like the reagents used during abstraction of various herbs, impurities coming directly from the manufacturing vessels, impurities from the used appropriately to promote the use of that herb so that these benefits can be realized for the promotion of public health and the treatment of disease., etc.

Chemical decomposition of substances present in the formulation also produces several toxic or impure compounds during storage in undesirable conditions. Contaminants may come directly from the atmosphere also. This include mainly dust, sulfur dioxide, H2S, CO2, Arsenic, moisture, etc

VI. CONCLUSION

Plants, herbs, and ethnobotanicals have been utilised for health promotion and disease treatment since the dawn of humans and are being used today in many parts of the world. The foundation of contemporary medicine today is made up of plants and other natural resources, which also significantly influence how commercial drug preparations are made today. Around 25% of medicines given globally are made from plants. However, plants are frequently employed in healthcare rather than pharmaceuticals. Some people prefer using herbal remedies as a form of medicine. Others utilise herbs as a complementary therapy to traditional medications. However, the only accessible or inexpensive form of healthcare in many underdeveloped nations is traditional medicine, of which herbal medicine is a vital component.Whatever the motivation, those who use herbal remedies should be sure the items they purchase are secure and contain what they claim to, whether this is a specific herb or a specified quantity of a certain herbal component. Science-based information on dose, contraindications, and efficacy should also be provided to consumers. Global legal harmonisation is required to do this in order to direct the ethical production and distribution of herbal medicines. Such legislation should permit this to be done if there is sufficient scientific evidence of a herb's benefits.

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