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Review: Conventional and Modern Extraction Methods of Herbal Drugs

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ABSTRACT: The richest bio-resource of drugs for conventional medical systems, contemporary medications, nutraceuticals, food supplements, folk remedies, pharmaceutical intermediates, and chemical entities for synthetic drugs is comprised of medicinal plants. Due to their extensive structural variety and broad spectrum of pharmacological actions, plants are respected in the pharmaceutical sector. Phytochemicals are the biologically active substances found in plants. The repositories of naturally occurring chemical substances and structurally varied bioactive molecules are the plants. The first crucial step in creating plant formulations is extraction. The foundation of natural product research is the extraction of chemicals from plant materials. Supercritical fluid, ultrasonic, accelerated solvent, microwave, and enzyme-assisted extraction technologies are a few of the potential contemporary green extraction techniques that are gaining importance. The contemporary extraction technique in the development of herbal medication technology is the main subject of the prepared review not only explains but also goes into detail on the numerous extraction methods utilized to extract the phytochemicals from the various plant parts.

KEYWORD: Modern extraction methods, Supercritical fluid extraction, ultrasound extraction, accelerated solvent extraction, microwave extraction, Herbal drug technology.

I. INTRODUCTION:

The utilisation of medicinal plants to treat and cure both acute and chronic ailments is generating a lot of attention. Extraction techniques, which are crucial, were the starting point of the study on medicinal plants. The selection of an appropriate extraction technique is a key factor in both qualitative and quantitative research of bioactive chemicals derived from plant sources. The use of plant materials in medicinal, dietary, and cosmetic applications is growing in popularity.Alkaloids, steroids, tannins, glycosides, volatile and fixed oils, resins, phenols, and flavonoids are only a few of the active substances that are found in plants and are deposited in many sections of the plant, including the leaves, flowers, bark, seeds, fruits, roots, etc. Plant materials generally combine these secondary metabolites to produce their beneficial therapeutic effects. Numerous chemical substances found in plants can be used to cure various ailments.We were forced to turn to ethnopharmacognosy because of microbial resistance to medications that were chemically synthesised.Thousands of phytochemicals that have been shown to be advantageous and to have biological effects like anticancer, antibacterial, antioxidant, ant diarrheal, analgesic, and wound healing activities were discovered.

Extraction is the process of separating a plant's active principle using the appropriate solvent. On the basis of the type of phyto-components found in plant material, the solvents are carefully chosen. By choosing a better procedure, the recovery, stability, and general quality of the extract can also be increased .Traditional methods are laborious and use more energy, time, samples, and solvents than their more recent counterparts. Multiple parameters can be controlled simultaneously and modern approaches are highly automatable. The most effective method is chosen to minimize sample and solvent usage. The recovered extract may have a higher yield and better quality than that made using a conventional approach, and a decent extraction may be accomplished in less time.

It entails the use of selective solvents in conventional extraction techniques to separate the medicinally active molecules of plant or animal tissues from the inert or inactive components (desired and undesired). The somewhat impure liquids, semisolids, or powders produced in this way by plants are only fit for external or oral consumption. While decoction and hydro distillation procedures employ water as a solvent, traditional extraction techniques like maceration, percolation, and soxhlet extraction often use organic solvents, need a huge volume of solvents, and take a long time to complete. The following is a discussion of the typical conventional extraction techniques used.

Table1: Solvents used for active component extraction

Water	Ethanol	Methanol	Chloroform	Dichloromethanol	Ether	Acetone
Tannins Anthocyanin Terpenoids Saponins	Tannins Terpenoids Polyphenols Flavonoids Alkaloids	Tannins Terpenoids Polyphenols Saponins Anthocyanin	Flavonoids Terpenoids	Terpenoids	Alkaloids Terpenoids	Flavonoid

Traditional extraction techniques:

1. Maceration: It is an affordable, time-tested method that has been used for years to prepare medicines.It's a technique for extracting solids from liquids. In this procedure, the solvent is introduced to a closed vessel containing the powdered solid components. It is permitted to stand for a long period of time (which might range from hours to days) with sporadic shaking.The solvent is given enough time to diffuse through the cell wall and solubilize the plant component.When the necessary amount of time has passed, the liquid is strained off, and the remaining solid is compressed to extract as much solvent as possible.

Advantages:

1.Maceration is a simple process that uses straightforward equipment.
2. An expert operator is not necessary.
3. Energy-saving techniques.
4. For some chemicals, prolonged contact with a solvent is ideal since they are very little soluble in it.
5. Effective strategy for less powerful and affordable medications

Disadvantages:

1. The extraction process takes a long time it can even take weeks to complete.
2.Not appropriate for completely extracting the medication.
3. It takes a long time and is a very slow process.
4. More solvent is needed.

2. Percolation: This method is employed most commonly to extract active substances when tinctures and fluid extracts are being made. A percolator is often a thin, conical-shaped vessel that is open at both ends. A suitable amount of the solvent is used to moisten the solid ingredients, and they are then allowed to stand for about 4 hours in a tightly sealed container before the mass is packed and the percolator's top is closed. A shallow layer of additional solvent is placed above the mass, and the mixture is then given 24 hours to macerate in the closed percolator. The percolator's outlet is then opened, allowing the liquid inside to trickle gradually. Until the percolate equals about three-quarters of the required volume of the finished product, additional solvent is added as needed.The liquid is then poured to the percolate after the extract is squeezed.The needed amount of solvent is added, and the mixture is then filtered to remove impurities.

Advantages:

1. It takes less time than maceration, which is an advantage.
2. Constituents that are thermolabile may be extracted.
3. Appropriate technique for powerful and expensive medications.
4. Rapid and more successful extraction.

Disadvantage:

1. Takes longer than ssoxhalation.
2. Additional solvent is needed.
3. A skilled individual is needed.
4. Throughout the procedure, particular attention should be paid to the material's particle size.

3. Decoction: When working with stiff, fibrous plants, barks, and roots, as well as plants that have compounds that are water soluble, decoction is the preferred procedure. The plant material is typically crushed or split into little bits before being put into clay-coated earthen pots or tinned copper containers. The pot is filled with water and cooked over a fire. For each part of the medicine that is soft, four parts of water are used; for drugs that are fairly hard, Eight times water is used, and sixteen times water is advised if the medicine is really

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difficult. In the case of soft drugs, the mixture is next cooked on a low heat until it is reduced to one-fourth of its initial volume, and to one-eighth in the case of moderately or extremely hard substances. After cooling and straining the extract, the filtrate is collected in clean vessels.

Advantages:
1. Suitable for extracting chemicals that are heat stable.
2. This technique doesn't need more sophisticated or expensive equipment.
3. It is simple to carry out.
4. Operators need not be trained.

Disadvantages:
It is not recommended for the extraction of heat-sensitive compounds, which is a drawback.

4. Soxhlet extraction: It is the most effective technique for the continuous extraction of a solid by a heated solvent, and it was developed by the German agricultural scientist "Franz Ritter von Soxhlet."The glass refluxing Soxhlet apparatus is a specialised tool used mostly for organic solvent extractions. Thesoxhlet device is filled with the powdered solid substance, which is contained in a filter paper thimble. The device is attached to a reflux condenser and a round-bottomed (RB) flask holding the solvent. The RB flask's solvent is gently boiled, and as the vapour rises via the side tube condensed by the condenser and falls into the thimble containing the material and slowly fills the soxhlet. The solvent eliminates the portion of the substance it has extracted when it reaches the top of the connected tube by syphoning over into the flask.is condensed by the condenser, it falls into the thimble holding the material and gradually fills the soxhlet.

Advantages:
1. Large amount of plants materials can be extracted at a time.
2. Recurring solvent use
3. This technique does not call for filtration following extraction.
4. The type of matrix is not relevant to this procedure.
5. It is a pretty easy method.
6. The frequent interaction of new solvent with the solid matrix can shift the transfer equilibrium.

Disadvantages:
1. Since the samples are cooked at a high temperature for a considerable amount of time, it is important to consider the possibility that some compounds could be thermally destroyed if the plant material contains chemicals that are heat labile.
2. The extraction procedure requires a lot of labour and takes a while.
3. The method enables for the manipulation of specific variables. Soxhlet extraction process is heavily criticised since it takes so long and requires so much solvent.

Modern extraction methods:
1. Microwave-assisted extraction (MAE):
MAE is a straightforward, environmentally responsible, and cost-effective method for removing physiologically active chemicals from various plant sources. In 1975, Samra et al. employed microwave home ovens for the first time to treat biological samples for metal analysis. Ganzler and colleagues published the first study on the use of MAE for plant materials in 1986.

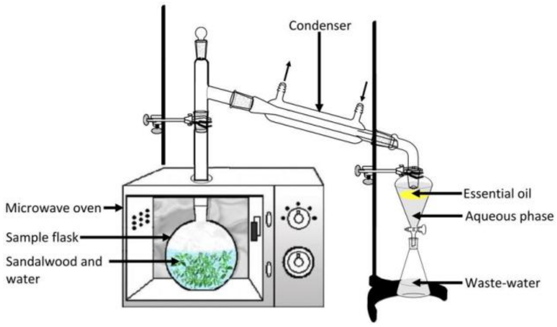

Fig. Microwave-assisted extraction (MAE)

It is also referred to as microwave extraction because it combines standard solvent extraction with a microwave. Microwave-assisted extraction, which improves the kinetics of extraction, involves heating the solvents and plant tissue using a microwave. The minuscule traces of moisture that exist in plant cells are the focus for heating in dried plant material. The minuscule traces of moisture that exist in plant cells are the focus for heating in dried plant material. Due to the microwave effect, this moisture inside the plant cell is heated, which causes evaporation and exerts a great deal of pressure on the cell wall. Pressure causes the cell wall to push outward from the inside, rupturing the cell. As a result, active components are expelled from the burst cells, increasing the amount of phytoconstituents produced.

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Advantages:

1. The procedure saves time because the extraction process can be finished in a matter of seconds or up to 15-20 minutes.
2 Low consumption of solvents.
3. Only a few millilitres of solvent are used in MAE increased yield from extraction.
4. The process can be precisely automated, improving process precision and accuracy.
5. The technique works with thermolabile plant components.

Disadvantages:

1.MAE usage necessitates specialised setup, raising process costs.
2.The work of developing this approach is currently ongoing.

2. Ultrasonication Assisted Extraction (UAE):UAE includes applying powerful, high-frequency sound waves and observing how they affect various materials. UAE is a technology that has the potential to be useful because it doesn't call for expensive or complicated equipment.During the treatment, ultrasound is used at frequencies between 20 kHz and 2000 kHz, which causes cavitation by making cell barriers more permeable.

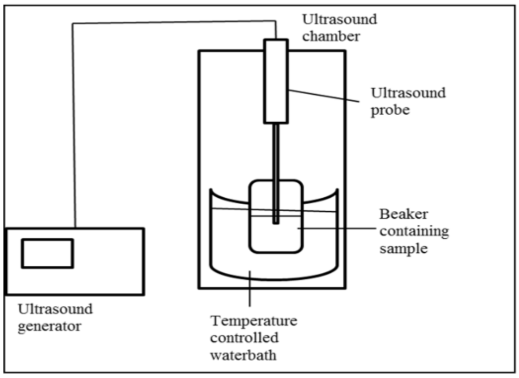

Fig. **Ultrasonication Assisted Extraction (UAE)**

Although the method has various applications, such as the extraction of rauwolfia roots, its wide-scale use is constrained by the method's higher costs.The key benefits of ultrasound are its quick response and preparation times, ability to use little material, effective use of solvents, and higher sample throughput. For the separation and purification of bioactive components, it is highly helpful.One drawback of the process is the sporadic, but well-known, harmful impact of ultrasonic energy (more than 20 kHz) on the active components of medicinal plants, which results in the creation of free radicals and therefore unfavourable alterations in the drug molecules.

Advantages:

1. Decrease of extraction and processing time
2.The amount of energy and solvents used, unit operations, and the lack of CO_2 emissions

Disadvantages:

1. High instrument and analytical cost
2. Limited extraction efficiency
3. Chances of impurities

3. Supercritical Fluid Extraction: Supercritical Carbon Dioxide Extraction (SFE) Systems extract chemical compounds without the need of an organic solvent. A fluid enters the supercritical fluid state when it is between the normal gas and liquid states and is above its critical temperature (Tc) and critical pressure (Pc). The item of interest can be solubilized and extracted selectively by adjusting the fluid's temperature and pressure. The sample is put in an extraction vessel and put under CO2 pressure to dissolve it. After being transferred to a fraction collector, the contents are depressurized, the CO2 loses its ability to serve as a solvent, and the targeted substance precipitates. You can recycle the condensed CO2.

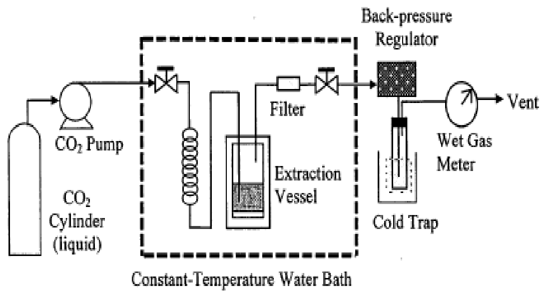

Fig. Supercritical Fluid Extraction

Advantages of SFE -

1. Extraction of constituents at low temperature, which avoids damage from heat
2. No solvents residue
3. Environment friendly
4. Better diffusivity
5. Low viscosity of supercritical fluid, which allow more selective extractions
6. Fast extraction

Disadvantages:

1.As the process is carried out under high pressure and high temperature.

2. It increses the operational cost of the extraction process.

SFE applications in the food, pharmaceutical, and fine chemical industries:

1. Decaffeinating of coffee and tea
2. Extraction of essential oils (vegetable and fish oils)
3. Extraction of flavors from natural resources (nutraceuticals)
4. Extraction of ingredients from spices and red peppers
5. Extraction of fat from food products
6. Fractionation of polymeric materials
7. Extraction from natural products

II. CONCLUSION:

The development and identification of new therapeutic chemicals rely heavily on medicinal plants. When separating and characterising various phytochemicals from herbs and searching through plant extracts for new leads, the extraction procedure is crucial. Traditional methods are labor-intensive and consume more energy, time, sample, and solvent than their more recent competitors .By choosing a more effective process, the recovery, stability, and general quality of the extract can be all be enhanced. MAE has been suggested as one of the most versatile current techniques for coupling with later separation and characterisation activities. This method is said to be speedier and more efficient than traditional extraction techniques including continuous off-line microwave assistance, ultrasound assistance, and Soxhlet extraction. Many parameters can be controlled simultaneously and modern approaches are highly automatable. The most effective method is chosen to minimise sample and solvent usage. The recovered extract may have a higher yield and better quality than that made using a conventional approach, and a decent extraction may be accomplished in less time. Methods such as SFE, MAE, and UAE are better suited for the extraction of heat labile and volatile compounds, which is not the case with the conventional methods.

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