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An Updated Review on Identification Authentication and Extraction of Herb

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A B S T R A C T

Plant identification is a fundamental step in classification, where nomenclature plays a crucial role in retrieving information and facilitating communication. This research introduces a straightforward and computationally efficient approach for plant identification utilizing digital image processing and machine vision technology. The suggested methodology has three distinct stages: pre-processing, feature extraction, and classification. The classifier utilizes these features as inputs for effective classification, and the results were evaluated and compared using Artificial Neural Network (ANN) and Euclidean (KNN) classifier. The experimental findings demonstrate that the proposed method attains superior recognition accuracy and enhanced classification efficiency compared to radial basis function neural network (RBFNN), BP neural networks (BPNN), and multi-Layer perceptron network (MLPN) for the identification of plant species. The fluorescence microscope and micro spectrometer are utilized for the authentication of powdered ASU medicines and the quantification of chemical dispersion inside the cross section of these drugs.

Keywords: Herbs, Decoction , Extraction, Soxhlet,

1. Introduction of herbal technology: -

A herbal is a written compilation of plant names and descriptions, typically including details about their medical, tonic, culinary, toxic, hallucinogenic, fragrant, or magical properties, as well as the folklore around them. An herbal can also categorize the plants it discusses, provide instructions for creating herbal extracts, tinctures, or potions, and occasionally incorporate mineral and animal remedies in addition to those derived from plants. Herbals were commonly illustrated to facilitate plant identification Dioscoride De Materia Medica, Byzantium, 15th-century manuscript, by which time the text had been in circulation for around 1500 year

Herbals were one of the earliest forms of literature created in Ancient Egypt, China, India, and Europe. They served as repositories of medicinal knowledge gathered by herbalists, apothecaries, and physicians. Herbals were among the earliest books to be printed in both China and Europe. In Western Europe herbals flourished for two centuries following the development of moveable type (c. 1470–1670).

In the late 17th century, the emergence of modern chemistry, toxicology and pharmacology decreased the medicinal usefulness of the traditional herbal. As reference guides for botanical research and plant identification herbals were displaced by Floras — systematic accounts of the plants found growing in a particular location, with scientifically precise botanical descriptions, categorization, and images. Herbals have enjoyed a minor rebirth in the Western world since the later decades of the 20th century, as herbalism are allied disciplines (such as homeopathy and aromatherapy) became prominent forms of alternative medicine.

Figure. 1 Materia Medika

2. DIFFERENT METHOD OF IDENTIFICATION OF PLANTS: -

One of systematics' main goals is identification, which is also one of its central activities. Classification and nomenclature are both incorporated into the process of identification, even though it is a distinct activity. Identification is the process of determining whether two things are the same or different, or more simply put, how similar or different they are from one another. Classification is also involved when comparing an unknown plant to a named specimen and determining whether the two elements are the same. That is, when an unknown plant is correctly identified as belonging to the same group (species, genus, family, etc.) as a known specimen, the data stored in classification systems becomes accessible and relevant to the material under consideration. Identification and categorization are two processes that call for a description of the similarities' criteria and entail comparison and judgment. Thus, identification is a fundamental process in categorization, with nomenclature playing an important role in information retrieval and communication. As Black welder (1967) puts it, "Identification enables us to retrieve the appropriate facts from the system (classification) to be associated with some specimen at hand" as well as "better described as the recovery side of taxonomy." In fact, one frequently recognizes a plant through direct comparison or the usage of keys and assigns it a name. This chapter examines the practical aspects and methodologies of plant identification and identification systems. For more detail, see Harrington and Durrell's book How to Identify.

2.1 EXPERT DETERMINATION METHOD: -

Identifying plants can be simplified by consulting an expert in the specific plant you're interested in. This method is more straightforward than figuring it out on your own. However, experts might not always be readily available as they could be occupied with other tasks. Experts can be incredibly knowledgeable about specific floras (like plants in Michigan or wetland plants) or certain plant groups (like sedges or orchids). They can specialize in broad categories (like all grasses) or very specific ones (like Cantua, a small genus of ten plants in Central and South America).

Experts can be found in various roles such as ecologists, taxonomists, agricultural extension officials, and even passionate natural history lovers. Universities, colleges, and organizations related to conservation and natural resources are common places to find these experts. State or regional botanical clubs can also be a great source of knowledge.

The definition of an "expert" can vary. A Ph.D. is not a mandatory requirement. Expertise can come in different forms and levels, and even self-proclaimed experts can sometimes be wrong. Therefore, even if you consult an expert, it's crucial to verify the identification yourself using methods like taxonomic keys, written descriptions, image comparison, and specimen comparison.

2.2 PLANT RECOGNITION METHOD:-

Plants are the fundamental support system for all terrestrial life forms and are essential for human welfare. Recognizing different plant species is crucial in agriculture for efficient plant management, while botanists may use this skill for medicinal purposes. Each plant leaf has unique characteristics that can be used for classification. This study presents a straightforward and computationally efficient method for plant identification using digital image processing and machine vision technology.

The proposed procedure consists of three stages: pre-processing, feature extraction, and classification. Pre-processing enhances the quality of data images before computational processing. The feature extraction stage extracts features based on the hue and shape of the leaf image. These features are then used as inputs to the classifier for effective classification. The results were verified and compared using Artificial Neural Network (ANN) and Euclidean (KNN) classifier. The network was trained with 1907 sample leaves from 33 distinct plant species from the Flavia dataset. The proposed method achieved 93.3 percent accuracy using the ANN classifier, and the comparison of classifiers reveals that ANN requires less average execution time than the Euclidean distance method.

In another research paper, a novel shape identification algorithm based on radial basis probabilistic neural network (RBPNN) is introduced. The orthogonal least square method (OLSA) is used to train the network, and the recursive OLSA is used to optimize the structure of the RBPNN.The experimental result shows that the RBPNN achieves a higher recognition rate and enhanced classification efficiency compared to radial basis function neural network (RBFNN), BP neural network (BPNN), and multi-Layer perceptron network (MLPN) for plant species identification.

3. AUTHENTICATION OF PLANT

3.1 Method of authentication of plant:

3.1.1 Macroscopic method:

The macroscopic features of botanical materials, such as their size, color, texture, odor, taste, and other organoleptic properties, are what determine their identity.

3.1.2 Microscopic method:

Microscopy is used to determine the structural, cellular and internal tissue properties of botanicals. It is mainly used to identify and differentiate two herbals that are comparable This is the commonly utilized technique, convenient, quick and may be applied to proprietary drugs Likewise an example of a plant that can apply microscopic techniques to aid in its identification is star anise (Illicium verum Hook's). As the name suggests, star anise is star shaped fruits that taste like anise; initially a native of southern China, it has now been imported across the tropics and subtropical Eastern Asia. The fruit is used largely as an aromatic spice in China and India to taste cuisine and sweets. It is known for its medicinal benefits in traditional Chinese medicine for treating rheumatism, back pain and hernias. Unfortunately, an increasing number of cases of newborns, suffering from severe neurological effects-such as seizure, vomiting and rapid eyeball movement have been reported in western countries and United States after the ingestion of star anise herbal tea.

3.1.3 Fluorescence Microscope:

Using the microscope to determine the identity of herbal remedies, particularly, microscopic authentication refers to analyzing cell structure and interior features using a microscope and its derivatives. Besides the usual light microscope, polarization and fluorescent microscopes can also be employed to enhance the accuracy of authentication. Use of these microscopes expands the amount of features accessible for use in identification. For example, it has been found that starch grains, crystals of calcium oxalate, stone cells, arteries and fibres exhibit stable and specific polariscopic features The fluorescence microscope detects the fluorescence released from herbal tissues under illumination. Many herbal tissues, by virtue of their chemical structures or secondary metabolites, have the potential to produce light of a specific wavelength following the absorption of light with a shorter wavelength and higher energy 25. For example, in recent years, the fluorescence microscope has been utilized to differentiate the medicinal herbs Oleander diffuse from other species of the same genus which are confused with it, in herbal markets. The fluorescence microscope and micro spectrometer can be used to authenticate powdered ASU medicines and quantify the distribution of chemicals in the cross section of these drugs.

3.1.4. Physicochemical methods:

Total ash, water soluble ash, acid insoluble ash and sulfurized ash are among the parameters. The identity can be determined by comparing these values of the individual drugs or the unique medications with the usual values of Indian pharmacopoeia.

3.1.5. Chromatographic methods:

High performance liquid chromatography capillary electrophoresis and thin layer chromatography are the most often used analytical method for herbal product the examination of volatile substance by gas chromatography is particularly essential in chemical analysis of herbal remedies.

4. DIFFERENT METHOD OF EXTRACTION OF PLANTS

4.1 Maceration: -

In this method, the entire or coarsely powdered crude medication is placed in a stoppered container with the solvent and left to stand at room temperature for a duration of at least 3days with frequent agitation until the soluble materials has dissolved. The mixture then is strained, the marc (the moist solid material) is pressed, and the combined liquids are purified by filtration or decantation.

4.2 Infusion: -

A brief maceration of the crude medication in either hot or cold water produces fresh infusions. These are diluted solutions of the easily soluble components of crude medicines.

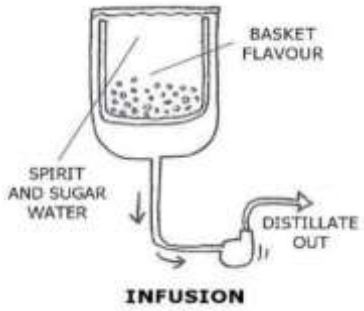

Fig 1.2 Infusion

4.3 Decoction

By this process, the crude drug is cooked for a predefined amount of time in a predefined volume of water, then cooled and filtered or strained. This process is suited for extracting water soluble, heat stable components. This procedure is primarily utilized in preparation of Ayurvedic extracts called “quash” or “Kawate”. The beginning ratio of crude drug to water is fixed, e.g., 1:4 or 1:16; the volume is subsequently lowered down to one-fourth its original volume by boiling during the extraction phase.

4.4 Percolation

This is the process used most frequently to extract active substances in the manufacturing of tinctures and fluid extracts. A percolator (a narrow, cone-shaped vessel open at both ends) is frequently employed. The solid ingredients are moistened with an appropriate amount of the prescribed menstruum and left to stand for approximately 4 h in a well closed container, The bulk is then crammed in and the percolator's lid sealed. Additional menstruum is added to produce a shallow layer above the mass, and the combination is left to macerate in the closed percolator for 24 h. The outlet of the percolator then is opened and the liquid contained therein is allowed to trickle slowly. Additional menstruum is added as required, until the percolate measures roughly three-quarters of the required volume of the finished product. The marc is then crushed and the expressed liquid is put to the percolate. The mixed liquid is cleared either by standing or by filtering after adding enough menstruum to achieve the required volume.

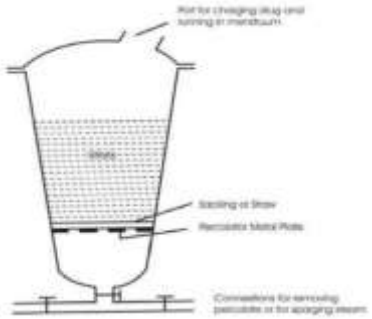

Fig 1.3 Percolation

4.5 Hot Continuous Extraction (Soxhlet)

With this method, chamber E of the Soxhlet apparatus has a porous bag or "thimble" constructed of robust filter paper containing the finely powdered crude drug. The extraction drips into the thimble containing the crude medication, and extracts it by contact. When the amount of liquid in chamber E climbs to the top of siphon tube C, the liquid contents of chamber E siphon into Fl ask A. This operation is continuous and is carried out until a drop of solvent from the siphon tube does not leave residue when evaporated. The advantage of this process, compared to previously disclosed procedures, is that huge amounts of medication can be extracted with a much less quantity of solvent. This impacts great economy in terms of time, energy and subsequently cash inputs. At small size, it is employed as a batch process alone, but it becomes considerably more affordable and practical when turned into a continuous extraction operation on medium or big scale.

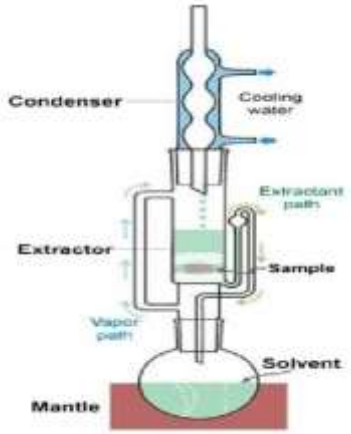

Fig. 1.4 Soxhlet Apparatus

4.6 Supercritical fluid extraction method:

Supercritical fluid extraction (SFE) has become one of the most prominent green extraction procedures currently as it has showed various advantages compared with regular or classical extraction processes. Aspects such as greater selectivity, larger extraction yields, better fractionation capabilities, and lesser environmental consequences have been vital to the important expansion of SFE. In this article, principles of SFE are discussed together with the most critical variables that might effect the extraction process and their tuning procedure. Moreover, fascinating and new applications in diverse disciplines such as food science, Pharmacognosy, and others like, for instance, heavy metals recovery are given is an instrumental technique not unlike PLE, only a supercritical fluid is utilized as the extraction solvent rather than a liquid. SFE and PLE load extraction vessels and prepare samples using the same methods, and static and dynamic extractions follow the same fundamentals.

SFE normally requires more pressure than PLE to sustain supercritical conditions and, for this reason, SFE frequently requires a restrictor to better manage flow and pressure of the extraction fluid. CO2 is by far the most frequent solvent used in SFE due to its comparatively low critical point (73 ATM and 31°C), extraction properties, availability, gaseous natural state and safety. A primary advantage of SFE over liquid-based approaches is that the extraction solvent becomes a gas after extraction and the analytes are conveniently concentrated in the collecting medium (solid-phase trap or liquid).

Liquid extraction methods nearly always require a concentration step following extraction. An other important characteristic of SFE is that temperature and pressure control can be used to significantly modify the density of the supercritical fluid and other physicochemical properties. This provides a somewhat better degree of selectivity and versatility in the extraction process without needing to employ multiple solvents. In some circumstances, SFE can eliminate post extraction clean-up processes, or at least make clean-up using SPE extraordinarily straightforward by employing the SPE sorbent as a trapping medium in SFE. Due to its many practical advantages.

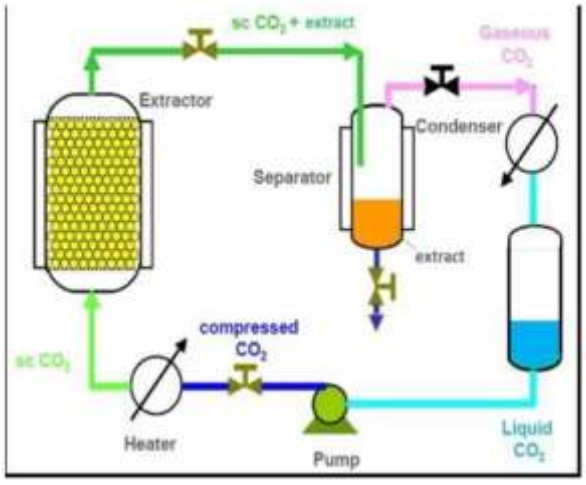

Fig 1.5 supercritical fluid extraction

4.7 Microwave assisted extraction

A procedure involving microwave-assisted extraction (MAE) followed by solid phase extraction (SPE) was established for the extraction and purification of three bibenzyl Lis quinoline alkaloids from Stephania capharnaum, and a reversed phase high-performance liquid chromatography (HPLC) method was developed for the quantification of the target alkaloids. Chromatographic separation was obtained on a Phenomenex Luna Phenyl-Hexyl column. Prior to the HPLC analysis, the alkaloids were swiftly extracted using an optimized MAE procedure employing 0.01 mol/L hydrochloric acid as the solvent. The MAE extract was further purified by SPE using a cation-exchange polymeric cartridge. The MAE–SPE technique extracted the three alkaloids with acceptable recoveries ranging from 100.44 to 102.12%. In comparison with the MAE, Soxhlet and ultrasonic-assisted extractions, the suggested MAE–SPE approach demonstrated satisfactory clean-up efficiency. Thus, the validated MAE–SPE–HPLC approach is specific, accurate and appropriate to the measurement of alkaloids in S. capharnaum Most analytical approaches for the measurement of alkaloids in S. catharanthine relies on chromatography. Because of the complexity of natural matrices, sample preparation combining both extraction and purification methods is necessary. A number of extraction techniques such as maceration, heat reflux extraction and ultrasonic-assisted extraction (UAE) have been applied to the extracts of S capharnaum prior to the chromatographic measurement of alkaloids (14–16). The former two techniques require extended extraction times (14, 15). The UAE approach involves a 40-min ultrasonication and overnight pre-soaking, and so is likewise time consuming (16). Microwaveassisted extraction (MAE) is a promising technique for the extraction of plant elements because of its simplicity, fast extraction time and minimal solvent usage (17, 18). Although this methodology was introduced for alkaloid extraction from S. capharnaum (19), the reported MAE method was employed solely for the extraction and hence was not validated for quantification. Moreover, the extraction solvent is complicated and contains a considerable amount of organic solvent, i.e., the upper phase of hexane–ethyl acetate–methanol–water (1: 1 :1: 1, v/v/v/v) containing 10% triethylamine (19). Therefore, there is a need to create a simpler and more ecologically friendly MAE method for the identification of alkaloids in S. capharnaum.

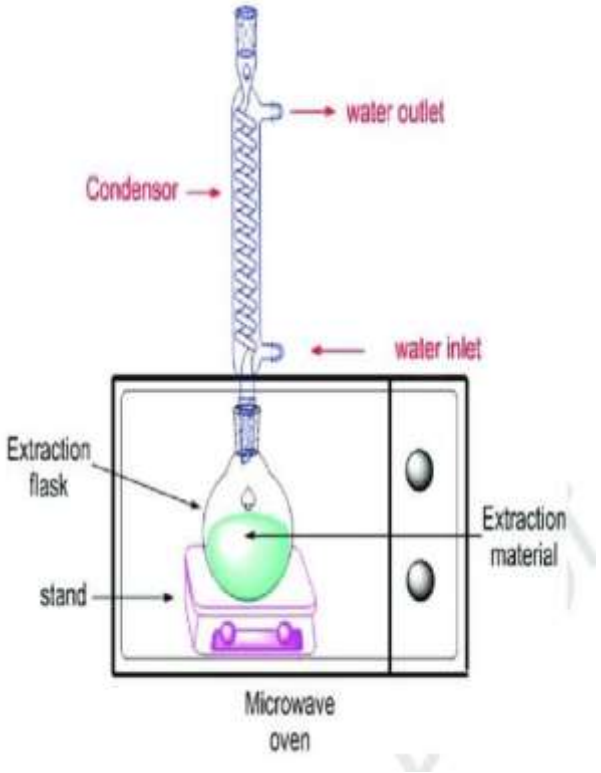

Fig. 1.6 Microwave assisted extraction Ultrasound assisted extraction

The treatment involves the use of ultrasound with frequencies ranging from 20 kHz to 2000 kHz; this enhances the permeability of cell membranes and generates cavitation. Even while the process works well in some situations, such as when rauwolfia roots are extracted, its widespread use is constrained by the higher expenses. One downside of the process is the occasional but known harmful effect of ultrasonic energy (more than 20 kHz) on the active ingredients of medicinal plants through production of free radicals and consequently undesired alterations in the drug molecule.

Applications

The application of ultrasound-assisted extraction (UAE) to the sample preparation of environmental and food samples has increased in the recent years. This methodology has been employed in the development of methodologies for the examination of several pollutants, including organic substances (pesticides, medicines, polycyclic aromatic hydrocarbons, polyhalogenated flame retardants, etc.) and heavy metals. The purpose of this paper is to review the applicability of this extraction process to the analysis of pollutants in food and soil.

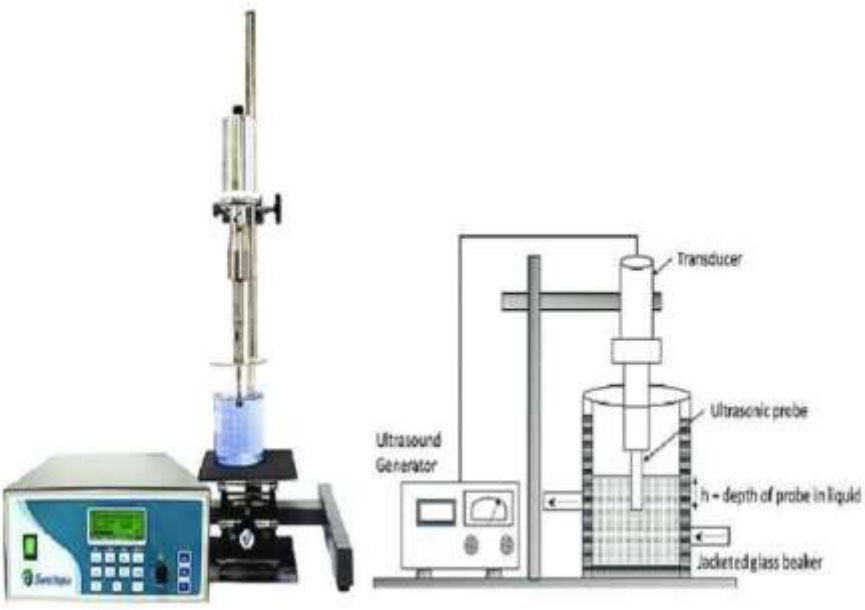

Fig 1.7 Ultrasound assisted extraction

4.8 Solid phase extraction

It is an extraction process that uses a solid phase and a liquid phase to isolate one, or one kind, of analyte from absolution? It is commonly used to clausulae before applying a chromatographic or other analytical method to quantify number of analyte(s) in the sample. The typical process is to load a solution onto the Spathae, wash away undesirable components, and then wash off the desired analytes with another solvent into a collection tube. The stationary phases employed in solid-phase extractions are the same ones found in liquid chromatography columns.. The stationary phase is enclosed in a glass or plastic column atop a frit or glass wool. The column might have a frit on top of the stationary phase and might also contain a stopcock to control the flow of solvent through the column. Commercial SPE cartridges have 1-10ml capacity and are discarded after use. It is frequently used to clean up a sample before applying a chromatographic or other analytical method to quantify the number of analyte(s) in the sample. Solid phase extraction technologies are used not only to extract traces of organic chemicals from environmental samples but also to eliminate the interfering components of the complex matrices in order to achieve a cleaner extract containing the analytes of interest. Analyte separation from a liquid matrix and purified extracts is a common use of SPE. This paper is a survey of the literature on general information about SPE technique, recent trends in SPE technique and its application.

Application: -

Solid phase extraction is commonly utilized in many different fields of analytical chemistry. Some of the key fields are environmental, biological, and food chemistry, where cleaning and preconcentration of the sample are important phases in the analytical technique. Molecularly imprinted polymers (MIPs) have gained attention because they show potential as compound - selective or group - selective media. These synthetic polymers can be used as sorbents to enable not only sample pre-concentration and cleaning but also selective extraction of the target analyte, which is important, especially when the sample is complex and contaminants can interfere with measurement. This paper evaluates the selectivity of MIPs in solid phase extraction of several kinds of analytes.

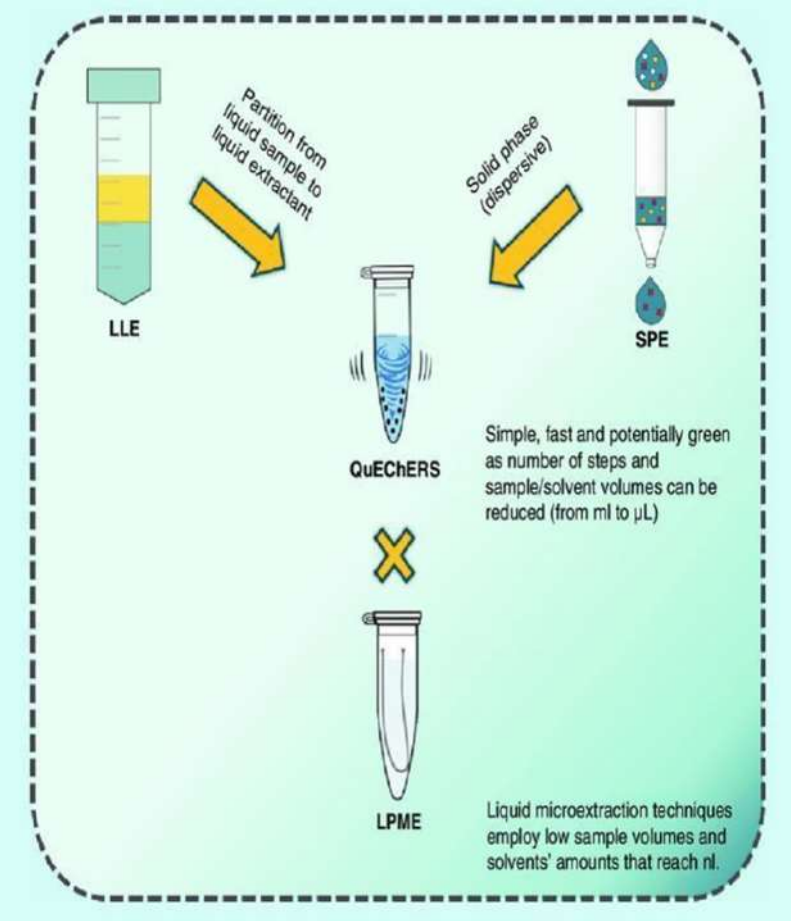

Fig 1.8 solid phase extraction

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