



Modern Extraction Techniques Applied in Pharmacy

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Abstract

From ages medicinal plants are used as drugs that help in healing from the different pharmacological aspects. By using different techniques which are found from Ayurveda, the essence is being extracted out and with the help of Ayurvedic science one can get the healing knowledge of medicinal plants. The several types of extraction techniques help in the screening of active pharmaceutical ingredient used in pharmacological investigation and also in drug usage. In today's GenZ era, the generation is looking out for the hidden remedies of ayurveda using different extraction processes that helps in healing all types of treatment without any harm. The main aim of this review paper is to review the different types of extraction techniques that are used in the pharmacy field which helps in extracting the bioactive compounds from the medicinal plants.

Keywords:

Extraction Techniques, Ayurveda, Phytochemicals, Bioactive Compounds

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Background

From past 5000 years, people have used different medicinal system to avoid any kind of impatient activity within the body. To circulate the body in a conventional manner it has always been important to follow the proper guidelines of ingesting the medicine for any type of treatment. Approx 75% of the total World's population depends upon traditional medicines. From generations, traditional medicines like Chinese and Ayurvedic medicines are in trend and have shown the excellent results on the human body. These traditional medicines are not only providing the conditioned growth to the human body but have also achieved popularity in different continents as well. Not only India and China has proved that traditional system works efficiently but also the countries like Hungary, Switzerland, Cuba, Mexico along with 16 other countries have seen the results in their population on different treatment where traits were found to be zero [1].

News headlines mentioned that, WHO and Govt. of India have signed the agreement to build WHO Global Centre of Traditional Medicine where an investment of approximately USD 250 Million was supported by Govt. of India. As per WHO, this agreement aims to reach the traditional medicine to every corner of the world so that it can save many lives and shields from any type of trait, if found. As per WHO Director-General, Dr Tedros Adhanom Ghebreyesus, mentioned that "For many millions of people

around the world, traditional medicine is the first port of call to treat many diseases. Ensuring all people have access to safe and effective treatment is an essential part of WHO's mission, and this new center will help to harness the power of science to strengthen the evidence base for traditional medicine. I'm grateful to the Government of India for its support, and we look forward to making it a success". [2]

Traditional medicines were ingested using extraction techniques and extracting a chemical from any plant part persist pharmacological activity affects effectively. In ancient times, these traditional medicines are often prepared by using extraction techniques. There are different types of techniques involved in the making of single chemical using such extraction techniques. These extracted chemicals are basically the bioactive compound which are used directly in crude form and sometimes gets diluted with water as well [3]. In today's era one can see the humans fighting against different types of disorders and to combat from those several multinational companies are using different novel techniques and extraction method to get the bioactive compound which can further be utilized in making different organic medicines.

Not even in traditional medicines, but also in the formulation of organic cosmetic products and essential oils, different types of extraction techniques are being used [4]. There are several extraction techniques which are used to extract the wide range of phytochemicals used in different procedures and ailments [5,6].

This paper basically aims to provide the extraction techniques in detail and how these techniques work against any ailment and in the formulations.

Ayurvedic Science

Ayurvedic science is an organic medicinal system which was originated in India approx. 5000 years ago. The term Ayurveda is derived from the Sanskrit words ayur (life) and veda (science or knowledge). Thus, Ayurveda translates to knowledge of life. It is also known to be a healing medicine system in different countries of the world. As per the recent research it had been found that about 80% of the population of India and Nepal are solely depends on Ayurvedic science. Ayurveda has a oldest history which was found and written in Vedas around which was transcript as the "science of life". Dr. Vasant Lad, one of the world's foremost experts in Ayurveda and director of the Ayurvedic Institute in Albuquerque, New Mexico, writes in his book "Ayurveda: The Science of Self-Healing," "Man is a microcosm of nature and so the five basic elements present in all matter also exist within each individual." He then goes on to describe how each element plays a role in the workings of the body. Space, for example, exists in the "mouth, nose, gastrointestinal tract, respiratory tract, abdomen, thorax, capillaries, lymphatics, tissues, and cells." [2,7-10].

As per Vedas Kerala is known to be "Gods own country", extremely calm, welcoming and persist scenic beauty. Kerala is also known as the birthplace of ancient healing medicinal science [11]. Ages ago ayurveda was used to heal the living beings using different techniques and basic extraction methods manually i.e. without using any machine or appliances, etc.

Ayurveda is based on the concept of connecting mind, body and soul. Ayurveda is said to be a self doctor or healer. It is basically a complete natural way of treatment has zero side effects and treats the sufferers with herbal extracts without using any chemical elements [10]. Not only India and Nepal but with the influence of usage in these two countries, Bangladesh, Pakistan, Sri-Lanka, UAE, Colombia, Malaysia,

Switzerland, South Africa, Cuba, Tanzania, Romania, Hungary, Latvia, Serbia and Slovenia are the countries where Ayurvedic treatment is regulated [9].

In Ayurvedic medicine, herbal remedies and natural ingredients are often used for healing and wellness purposes. The extraction of these natural ingredients can be done through various methods such as steam distillation, cold pressing, maceration, and decoction.

Steam distillation is a process in which steam is passed through the plant material to extract the essential oils. Cold pressing is another method that is often used for extracting oils from citrus fruits. Maceration involves soaking the plant material in a solvent, such as alcohol or oil, to extract the active ingredients. Decoction is a method in which the plant material is boiled in water to extract the active compounds. In Ayurveda, the extraction process is often considered important to preserve the natural properties and efficacy of the ingredients. The extracted ingredients are then used in various forms such as powders, oils, and pastes for therapeutic purposes [3]. It is important to note that while Ayurvedic remedies have been used for centuries, the safety and efficacy of these remedies have not been extensively studied and regulated by modern medical standards. It is always recommended to consult a qualified healthcare professional before using any Ayurvedic remedies.

Extraction

Extraction is a process of extracting out the biologically active chemical constituents from the plants which are useful in treating several ailments of living beings. It is an isolation technique where the procedure is done by using different solid, liquid and gaseous based solvents. By using this technique one can selectively uproot the chemical compound which is required to be majorly in use for a particular treatment. The extraction process is fundamentally being performed on immiscible liquids which means it's in between solvent and mixture. Extracting caffeine from coffee is one of the best examples we can find in our house only. Taking the coffee which is a mixture of coffee beans and adding water which acts as a universal solvent and further mixing coffee in boiling water will provides a brown colored mixture gets strain out from the unit which is known as caffeine. Here coffee is a main bioactive constituent which helps in increasing attention and alertness by gaining energy and ability to concentrate on a particular work [12].

Bioactive compounds are found from different parts of medicinal plants which constitute different phytochemicals and these derived phytochemical compounds are used in the formulations in pharma industry [13]. Many of these remedies contain bioactive phytochemicals that are believed to have beneficial effects on the body [14]. Here are some examples of bioactive phytochemicals used in Ayurveda:

Curcumin: This is a bioactive compound found in turmeric, a spice commonly used in Indian cuisine. Curcumin has anti-inflammatory and antioxidant properties and is used in Ayurvedic medicine to treat a variety of conditions, including arthritis, digestive problems, and skin disorders [15].

Piperine: This is a bioactive compound found in black pepper. Piperine is extracted from *Piper nigrum*, Linn. Piperine has been shown to improve digestion, enhance the absorption of nutrients, and have anti-inflammatory effects [16].

Ashwagandha: This is a plant that is commonly used in Ayurvedic medicine to treat stress and anxiety. The active compounds in ashwagandha, called withanolides, have been shown to have adaptogenic effects, meaning they help the body cope with stress [17].

Brahmi: This is a herb used in Ayurvedic medicine to improve cognitive function and memory. The active compounds in Brahmi, called bacosides, have been shown to have neuroprotective effects and may help improve cognitive function [18].

Guggul: This is a resin extracted from the Commiphora mukul tree, which is native to India. Guggul has been used in Ayurvedic medicine to treat a variety of conditions, including high cholesterol, arthritis, and obesity. The active compounds in guggul, called guggulsterones, have been shown to have anti-inflammatory and cholesterol-lowering effects [19].

Extraction Techniques Applied in Pharmacy

In any experimental process, the methodology of extracting out the bioactive compound hides in the medicinal plant and the techniques that are involved in the process. The bioactive fractions that are obtained from different medicinal plants are used in several formulations and have great medicinal value.

The different stages of extracting the bioactive compounds using extraction techniques can be processed by researching the medicinal plant, washing, drying the particular plant part, using different extraction techniques, appropriate solvent, phytochemical analysis using different screening techniques, and reporting [6,20].

The different extraction techniques used at different environmental conditions are discussed below:

1. Maceration
2. Percolation
3. Decoction
4. Infusion
5. Digestion
6. Powdered extraction
7. Reflux extraction
8. Soxhlet extraction or Hot continuous extraction
9. Pressurized liquid extraction
10. Supercritical fluid extraction
11. Ultrasound assisted extraction or Sonication extraction
12. Microwave assisted extraction
13. Accelerated solvent extraction
14. Supercritical fluid extraction

Maceration

It is a process where the medicinal plant part is kept with an appropriate solvent of choice and the mixture is further kept for approximately three days. This mixture is further distilled or filtrated and removal of the entire bioactive compound is extracted from the solid dump. Thereafter, the filtered bioactive product is sent for the phytochemical analysis and is further used as a bioactive molecule [21,22].

Percolation

It's a technique where the used apparatus is termed as percolator which a narrow cone shaped glass vessel with both ends open. In this, the plant material is collected, sun dried, grinded and kept in powdered form by dipping in with an appropriate solvent of choice for around 4 hours and further transferred to the percolator chamber for around 24 hours. After 24 hours the lower end of the percolator is opened and allowed to extract out and upto 75% of the biomolecule is collected finally for the further process [22].

Decoction

This process is performed by mixing the powdered drug into the sufficient amount of water (universal solvent) in a ratio of 4:1 or 16:1 in general. Further heat is transferred into the apparatus and lastly bioactive molecule is being extracted out from the apparatus [20].

Infusion

It is a process of extracting the bioactive compounds from the different plant parts by keeping the plant part in the solvent for long hours. E.g. keeping the fresh fruits in the distilled water and infusing the active chemicals from the jar whenever required [22].

Digestion

a process in which a drug is extracted from a natural source, such as a plant or animal tissue, using enzymes or other digestive agents. The extracted drug can then be purified and prepared for use in pharmaceuticals. Digestion extraction is often used for the production of natural drugs and herbal remedies, as it allows for the isolation of specific compounds with therapeutic properties [21,22].

Reflux extraction

It is a liquid-solid extraction process kept at a certain temperature with repetition of solvent by evaporation and condensation simultaneously for few minutes without losing any amount of solvent [23].

Soxhlet extraction or Hot continuous extraction

In this method, the coarsely ground powdered drug is kept in the bag and put it in the solvent for some time. The process of condensation is performed and allowed to drip in the thimble that contains crude drug. By doing this method, smaller amount of solvent is needed to extract large quantities of the drug [24].

Pressurized liquid extraction

Pressurized liquid extraction (PLE) is a sample preparation technique used in analytical chemistry to extract analytes from solid or semi-solid matrices. PLE involves the use of a pressurized solvent, typically water or an organic solvent, to extract the target analytes from the sample. The sample is placed in an extraction vessel, which is then filled with the solvent and heated to high temperatures under pressure. The high pressure and temperature help to break down the sample matrix and allow for efficient extraction of the analytes [25].

Supercritical fluid extraction

Supercritical fluid extraction (SFE) is a separation technique that utilizes supercritical fluids as the extracting solvent. A supercritical fluid is a substance at a temperature and pressure above its critical point, where it exhibits properties of both a gas and a liquid. SFE is used to extract various compounds

from solid or liquid matrices such as natural products, food, pharmaceuticals, and polymers. The process involves three main steps:

- Loading the sample into an extraction vessel
- Bringing the supercritical fluid to the desired temperature and pressure, which allows it to penetrate the sample and solubilize the target compounds
- Collecting the extracted compounds in a separate vessel as the supercritical fluid is depressurized and returns to its gaseous state. [26].

Ultrasound assisted extraction or Sonication extraction

Ultrasound-assisted extraction (UAE), also known as sonication extraction, is a method of extracting compounds from various materials using high-frequency sound waves. This method is commonly used in the food, pharmaceutical, and chemical industries to extract bioactive compounds from plant materials, such as herbs, fruits, and vegetables [27].

Microwave assisted extraction

Microwave-assisted extraction (MAE) is a type of extraction technique that utilizes microwave energy to enhance the extraction of compounds from various matrices such as plants, food, and pharmaceuticals. In this method, the sample is placed in a solvent and subjected to microwave radiation, which causes the solvent to heat rapidly and creates pressure inside the sample. This pressure, in turn, facilitates the extraction of the desired compounds from the sample. MAE has several advantages over traditional extraction methods, including faster extraction times, reduced solvent consumption, and improved extraction efficiency. It has been used to extract a wide range of compounds, including essential oils, bioactive compounds, and natural pigments. However, it is important to note that the MAE method requires careful optimization of various parameters, including the power and duration of the microwave irradiation, the type and volume of the solvent, and the sample-to-solvent ratio, to ensure maximum yield and quality of the extracted compounds [28,29].

Accelerated solvent extraction

Accelerated solvent extraction (ASE) is a modern technique used to extract analytes from solid or semi-solid samples using solvents at high temperatures and pressures. It is a fast and efficient extraction method that can be used for a variety of applications, including environmental, pharmaceutical, food, and forensic analysis. The ASE process involves placing the solid sample into a stainless steel extraction cell, followed by adding the solvent. The cell is then heated to a high temperature and pressurized, causing the solvent to become supercritical, which increases its ability to dissolve the target analytes. The extracted analytes are then collected in a separate container [29-31].

Conclusion

The use of novel techniques of extraction in pharmacy has revolutionized the field of pharmaceuticals. These techniques have enabled the extraction of active ingredients from various natural sources such as plants, animals, and microbes in a more efficient and sustainable way. Some of the novel techniques of extraction used in pharmacy includes supercritical fluid extraction, ultrasound-assisted extraction, microwave-assisted extraction, and pressurized liquid extraction. These techniques have shown

advantages over traditional extraction methods such as Soxhlet extraction and maceration, as they require less time, solvent, and energy consumption while maintaining the quality and quantity of the extracted compounds. Additionally, these novel techniques of extraction have also contributed to the discovery of new bioactive compounds with potential therapeutic applications. They have expanded the range of natural sources that can be used for drug development and have opened up new avenues for research in the field of pharmacy.

In conclusion, the use of novel techniques of extraction in pharmacy has proven to be a valuable tool in the extraction of active ingredients from natural sources. These techniques offer several advantages over traditional methods and have contributed to the discovery of new bioactive compounds with potential therapeutic applications.

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Conflict of Interest

There is no conflict of interest in between the authors.

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