

Medicinal Plants: Drying and Extraction Methods

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Abstract

Drying methods and extraction methods have evolved into modern approaches, and green drying and extraction methods can therefore be used as sustainable and eco-friendly alternatives to conventional ones. The "green" approaches focus on decreasing environmental consequences via lower energy requirements, reducing hazardous chemicals usage, and maintaining bioactive compounds quality. Methods like cabinet drying, shade drying and sun drying remove moisture quickly, as do these methods, preserving the constituents of the plant. Green extraction methods such as microwave-assisted extraction, ultrasound-assisted extraction, Soxhlet extraction and accelerated solvent extraction enhance selectivity and extraction yields and minimize the use of solvents.

Different drying methods:

The Medicinal plants and their parts are dried to remove the moisture content so their phytochemical constituents are effectively analyzed. Furthermore, the drying technique could significantly affect the retention and degradation of phytonutrients present in it. Herbs and spices are frequently regarded as medicinal plant species that have been utilized as traditional remedies since ancient times. However, herbs are often seen as highly susceptible to spoilage due to microbial growth and chemical changes caused by their vulnerability to low temperatures and excessive moisture content. Consequently, herbs and spices undergo drying processes to facilitate easier and more stable transportation and storage. These methods have thus enabled greater access to herbs and spices that may not be available locally and allowed for the continued use of these plants. There are different drying methods such as follows:

Green method used in drying:

- Solar drying:** India has been drying food grains since time immemorial in the open fields. During the industrial revolution, controlled solar drying was adopted to give an enhanced flavor, quality, and appearance to agricultural products. A solar dryer is usually a box made of readily available and low-cost materials such as cement, galvanized iron, brick, and plywood, covered with transparent single or double-layer sheets. This process significantly



decreases the moisture content in food, increases its nutritional value, inhibits the growth of mold, and retains the flavor and smell of different ingredients.

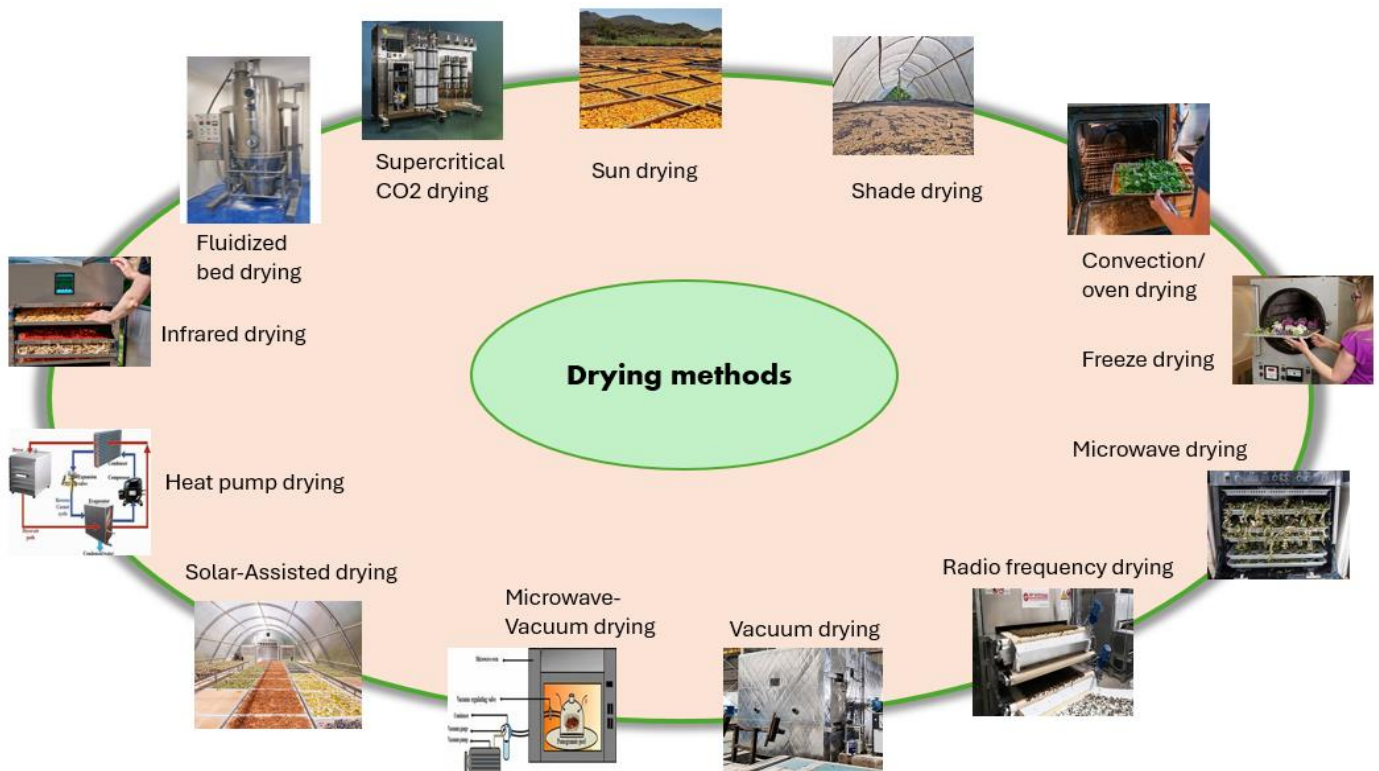


Fig. 1: Methods used for drying of medicinal plants

2. Cabinet drying: In rural areas, large-scale drying systems, like cabinet dryers, are often used. These dryers are relatively inexpensive and simple to build. They are suitable for drying all kinds of products, such as fruits: grapes, dates, apples; vegetables: onions, cabbage; herbs: parsley, basil, mint, dill. The inlet air temperature for cabinet dryers is usually kept at 60–80°C. They are also used in batch drying solid foods in smaller to moderate-sized batches that are from 2,000 to 20,000 kg a day. It will take a few hours depending on the condition for the dryer to dry it - from 2 to 10 hours.

3. Shade drying: Shade drying is used for those ingredients that are likely to lose their color when exposed to direct sunlight. It is done in natural airflow and at ambient temperatures, averaging about 25 °C, for 36 hours.

Plant consists of many active ingredients and secondary metabolites that possess biological activity. The whole plant may have these metabolites or only some of its parts contains them. Medicinal plants are collected at the right time, dried using any of the suitable techniques, grinded and then extracted to get these active metabolites. There are many extraction methods in which the solvent used for extraction is called menstruum. The choice of solvent depends on various factors like plant type, plant part, nature of the metabolite, availability of solvent, selectivity of solvent,

safety of solvent, cost of solvent, reactivity of solvent, recovery of solvent, viscosity of solvent, boiling temperature of solvent and solubility of solvent

Based on the law of similarity and intermiscibility (like dissolves like), solvents with a polarity value near to the polarity of the solute are likely to perform better and vice versa. Commonly used solvents are as follows: *n*-Hexane, Petroleum ether, Diethyl ether, Ethyl acetate, Chloroform, Dichloromethane, Acetone, *n*-Butanol, Ethanol, Methanol and Water. During fractionation, the selected solvent is added according to the order of increasing polarity, starting from *n*-hexane, the least polar to water with the highest polarity.

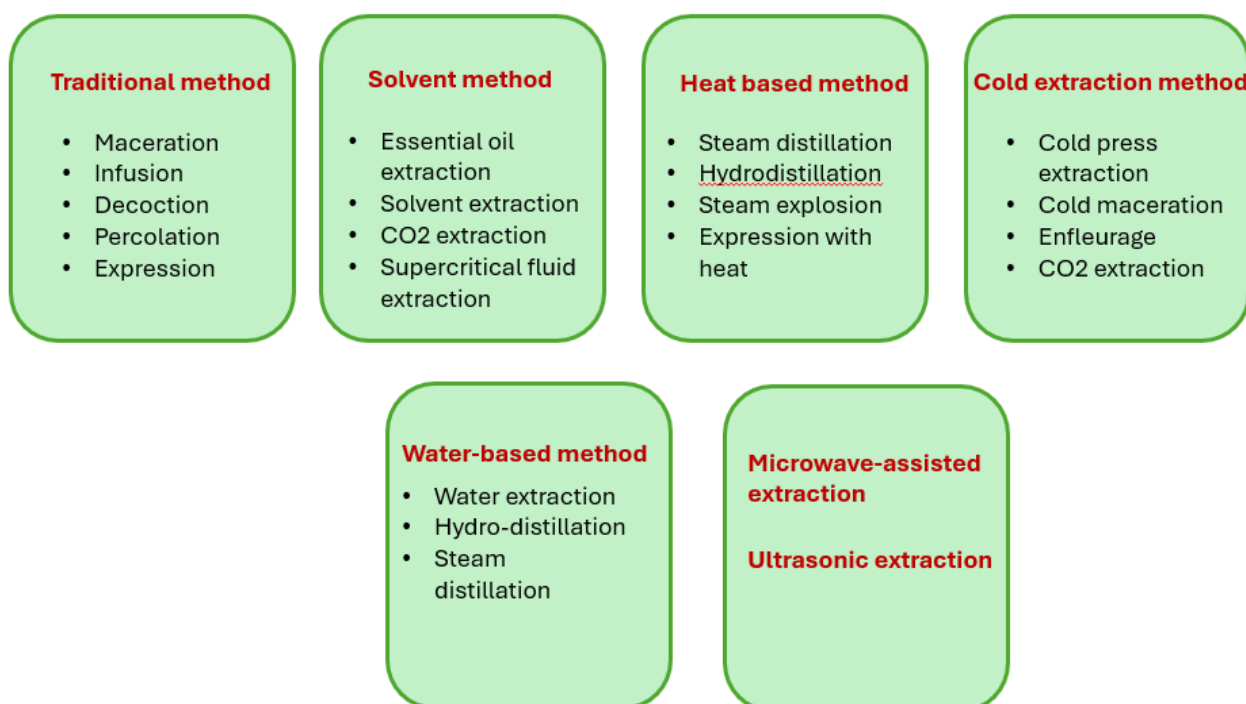


Fig. 2: Methods used for extraction of medicinal plants

Green methods used in extraction:

1. **Microwave-assisted extraction:** One of the new advancements that have come into the field of microwave-assisted extraction is a method for obtaining the active ingredients from medicinal plants, using microwave energy to disintegrating the cell membrane, as a result, diacylglycerols are released from the cell into the organic solvent, which allows the analyte to be separated from the sample matrix to the solvent. It is very rapid in view of the fact that the sample and the solvent are brought from room temperature to the boiling point, whereas the analytes thus extracted include those that are unstable when heated. The process normally requires the time of 15-20 minutes, although some reports do point to the maximum amount of metabolite production that may be achieved at as little as 30 seconds through microwave-assisted extraction.



2. **Accelerated solvent extraction:** AES is a type of extraction that was built in such a way that it could withdraw organic compounds from the solid or semi-solid samples with the help of liquid solvents. The temperature is raised in the extraction process and the high pressure keeps the solvent in a liquid state. Furthermore, the pH-hardened pathway makes it possible to extract matrices that have been treated with acids or bases.

3. **Soxhlet extraction:** Having made its first appearance back in 1879, the traditional Soxhlet extraction procedure has been the method that has nearly always been done in every analytical laboratory. The Soxhlet extraction uses a solvent evaporating-condensing cycle in its operation. The samples could be soil, sediments, animal, and plant tissues. The minimum duration required for traditional Soxhlet extraction procedures is usually a day. These processes are advantageous to things that cannot be heated for a long time since the substances will disintegrate.

4. **Ultrasonic-assisted extraction:** Sound waves correspond to changes in stress, particle displacement, and particle velocity inside an elastic medium. When the waves hit a high frequency range, they are known as ultrasonic waves. Ultrasonic waves differ from electromagnetic waves in that they are mechanical and have the capability to travel through all types of media including solid, liquid, and gaseous. The prevalence of ultrasonic technology, along with some practical applications in medical testing, non-destructive assessment, distance measurement, welding, cleaning, and food technology has been proven. The use of ultrasonic technology is usually split up into two categories like low-intensity ultrasonics and high-intensity ultrasonics. High frequencies that range from 5 to 10 MHz and a power level of under 1 W/cm² are the two features of low-intensity ultrasonics. This is a non-destructive type and it is very good at the testing and characterization of various materials, thus it is also called diagnostic ultrasonics.

Conclusion:

Drying and Extraction techniques for herbs are crucial in acquiring valuable compounds from plants, thereby improving their overall quality and effectiveness. There is a range of drying and extraction methods available, from traditional to contemporary techniques, each suited for various applications and desired results. Selecting the appropriate drying and extraction method necessitates careful evaluation of factors such as efficiency, selectivity, safety, cost, and environmental impact. Traditional techniques provide simplicity and accessibility, while modern methods offer improved efficiency, selectivity, and yield. A green approach for drying and extraction from medicinal plants is a sustainable and eco-friendly technique for the overall processing of medicinal plants. Energy consumption is low, and chemicals are used to a very limited extent, ensuring that the quality of the phytochemicals is maintained. It is essential to continue developing this area for further optimization of these methods for enhanced efficiency and utilization of a broader range of medicinal plants.



Adopting green technologies, the medicinal plant industry will, in the long run, remain sustainable, yet the herbal products will be safe, effective, and of quality.

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