

CHAPTER 7 TECHNOLOGIES IN HERBAL PROCESSING

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7.1 OVERALL FLOW OF HERBAL PROCESSING

The production of herbal products follows a structured process as illustrated in Figure 7.1. The process begins with the preparation of raw materials, extraction, purification, and product formulation. The first step of raw material preparation involves handling plant material through drying, grinding, or other pre-treatment methods to increase the efficiency of extraction. Once the raw material is ready, the next stage isolates bioactive compounds using various extraction techniques. The common traditional method like soxhlet extraction relies on solvent to repeatedly extract active compounds for days. While the preferable modern approach like supercritical carbon dioxide extraction uses carbon dioxide in a supercritical state.

The supercritical carbon dioxide offers a cleaner and more environmentally friendly alternative. Additionally, microwave and ultrasound-assisted extraction uses energy waves to break down plant cells efficiently to significantly increase the extraction yield. Microwave-assisted extraction has been shown to significantly enhance the extraction of phenolic compounds, especially under specific conditions

like 110°C, leading to a higher efficiency and improved herbal extract quality (Tarapatskyy et al., 2021). Similarly, ultrasound-assisted extraction disrupts cell walls using sound waves, increasing the release of phytochemicals and yielding higher concentrations of bioactive compounds (Kumar et al., 2023). Other advanced techniques, including green extraction and pressurized methods prioritize eco-friendly solvents and controlled conditions to enhance extraction efficiency while promoting sustainability. Based on Figure 7.1, it is known that extraction is very important in herbal processing industries.

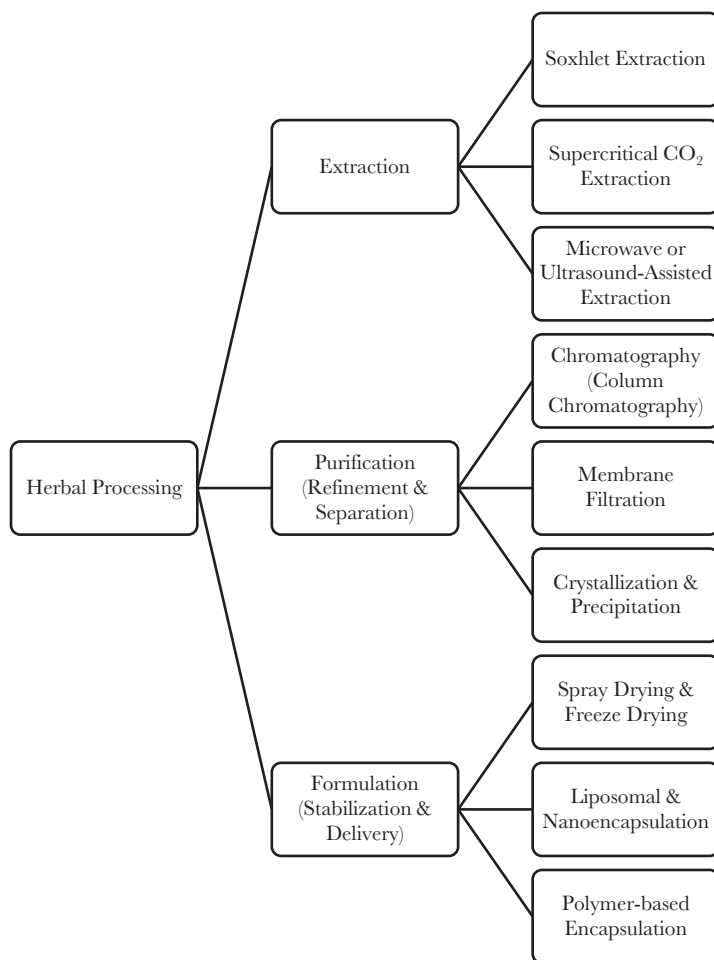


Figure 7.1 Processing flow diagram of herbal products

Effective herbal extraction requires careful consideration of several factors to ensure the maximum recovery and stability of bioactive compounds. One of the factors is solvent selection. The choice of solvent is crucial as solvent polarity determines the types of phytochemicals in the herbal extracts. Food grade solvents such as water and ethanol are preferable for extracting polar phytochemicals or water-soluble plant constituents to formulate and develop products for human consumption. On the other hand, the use of non-polar solvents such as petroleum ether, hexane and acetone might be applied to extract non-polar compounds from herbal materials. Essential oils consisted mostly of terpenes and sesquiterpenes are hydrophobic compounds which are not soluble in aqueous solvent system. Similarly, tocopherols or vitamin E are lipid soluble compounds and therefore, researchers used hexane as the solvent for extraction. Recently, supercritical carbon dioxide has been considered as green solvent for vitamin E extraction, due to the toxicity of hexane. These are the cases using non-polar solvents in the extraction process.

Although solvent type has been considered, solvent composition and solvent-to-solid ratio also play an important role to obtain high yield of target phytochemicals. Many researchers have reported 70–80% ethanol would be better in extracting flavonoids and phenolic compounds from plant samples. In the study of Nandasiri et al. (2019), 70% aqueous ethanol and methanol are more efficient in extracting phenolic compounds from canola meal which is by-product of oil pressing and rich in phenolic antioxidants using the accelerated solvent extraction method. From the findings, solvent selection including its composition in the whole extraction system is very critical to determine the yield and success rate of extraction. Besides solvent, extraction temperature and time are other factors influencing the extraction efficiency and selectivity. These factors are critical to preserve heat-sensitive plant constituents. For instance, anthocyanins are powerful antioxidant and thermal labile compounds, mostly present in colored plant leaves, flowers or fruits. Therefore, optimizing suitable extraction temperature and duration are of great importance (Oancea, 2021).