

A Review on: Advanced herbal Drug Technology

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Abstract –

Recently, people have become increasingly interested in medicinal plants because of their many benefits. Herbal preparations are widely accepted as therapeutic agents for various diseases. Although most of these uses are unconventional, it is known that over 80% of the world's population relies on medicinal plants and % rely on a healthy lifestyle. This increasing use of herbal products has also led to various forms of product abuse and adulteration, leading to disappointment among consumers and manufacturers and, in some cases, catastrophic consequences. Developing Authentic analytical methods that enable reliable phytochemical profiling, including Quantitative analyzes of bioactive markers/compounds and other important components, represents a major challenge for scientists.

Standardization is an important step in establishing a consistent biological activity, a consistent chemical profile, Or simply a quality assurance program for the production and manufacturing of herbal medicines. This review article describes various Convection processes as well as recent developments. Recent developments include DNA fingerprinting, Metabolomics technique, pulsed differential polarography, chemometric studies, X-ray diffraction, etc. The contribution of capillary electrophoresis and chromatography techniques to the standardization of medicinal plants has also been reported.

Keywords -Chemometric studies, standardization, catastrophic, Authentic

I. Introduction -

A medicinal product is a substance with nutritional, medicinal or preventative properties, while the term “herbal” refers to a botanical or herbal preparation. Therefore, the term “phytotherapy” refers to substances of plant origin that have

nutritional, healing or preventative properties. Phytotherapy is an interdisciplinary branch of phytotherapy and Ayurveda as it includes all areas of phytotherapy related to botany, herbal medicine, pharmacognosy, phytochemistry, phytotherapy, botanical medicines, Ayurveda, natural chemistry, agricultural science, Unani medicine, biotechnology and biochemistry. A person who deals with herbs, especially medicinal herbs, is called a herbalist.

History –. Nowadays, several advanced techniques such as MST technology are used in modern drug research to measure molecular interactions. But the Method of drug discovery was not always so sophisticated. A few hundred years ago, when medicine emerged from plants, these substances added

Therapeutic properties that were discovered through trail and error and spread by word of mouth, but very little was known about them. About why everyone played the way they did.

Recent developments have been reported in the areas of DNA fingerprinting, metabolomics, pulsed differential polarography, chemometrics, X-ray diffraction, etc. The contribution of chromatographic methods and capillary electrophoresis to the standardization of medicinal plants has also been reported.

Different methods of identification of plant –

1.Expert determination -The best identification method is to identify the expert based on the reliability or accuracy of the process when there are differences between the parts of a single expert. Determine the topic. The rating rules can only be applied if both parties make an appropriate agreement with the ratings. Typically, experts have produced studies (monographs, versions, summaries) on a particular group, and more recent studies or handbooks are likely to contain Expert concepts on the taxa. Experts can usually be found in botanical

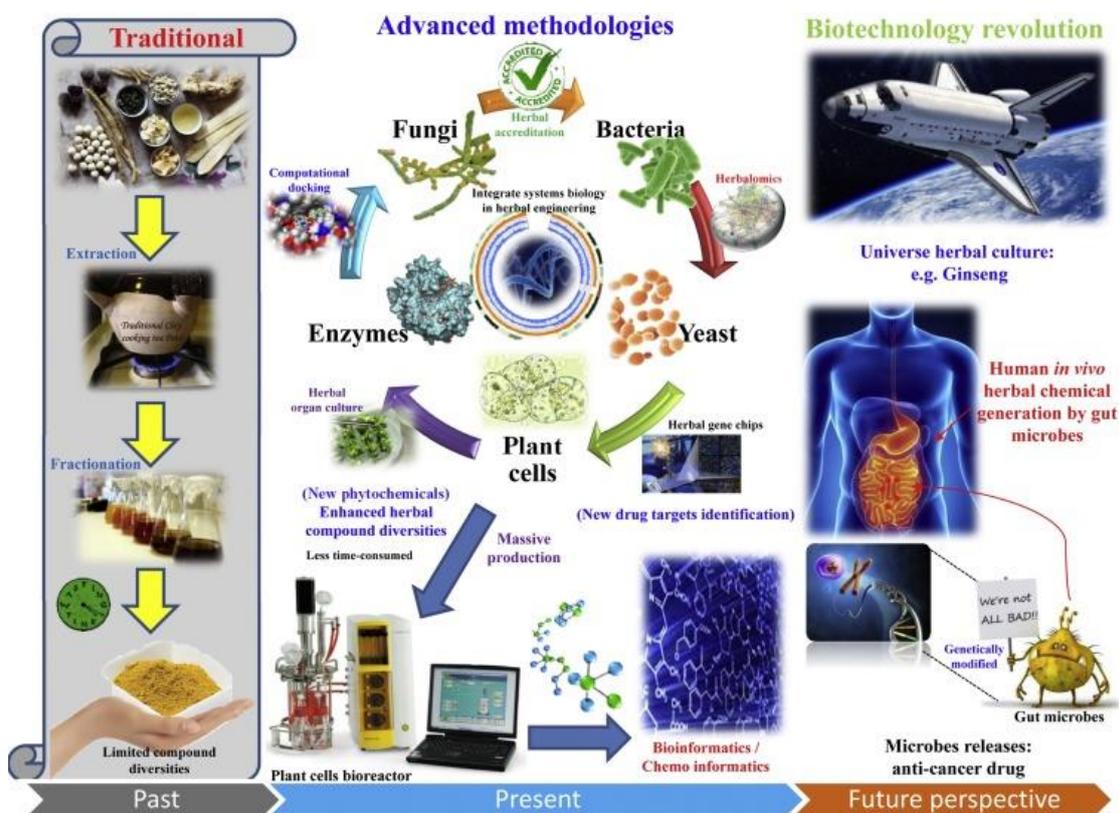
gardens, herbaria, museums, colleges, universities, etc.

2.Rating -In terms of reliability, it is close to the expert Rating. This is based on extensive previous experience in identifying with the factory group. In some groups this is practically impossible. Comparison The third method is to compare the unknown with the named. This comes close to an expert determination of reliability. This is based on extensive past experience with the facility group ID in question.

3.Comparison: The third method is to compare the unknown with named specimens, photos, illustrations, or descriptions. Although it is a reliable method, it can be time-consuming or even impossible due to a lack of suitable comparison materials.

(4) Use of keys and similar aids (summaries, diagrams, etc.): This is by far the most commonly used method And does not require the time, equipment or experience required for comparison and recognition.

Authentification of plant-



Herbal authentication is a quality assurance process that ensures that appropriate plant species and parts are used as raw materials for medicinal plants.

The authenticity of herbal raw materials is extremely important for the safety and effectiveness of herbal medicines. Morphological, anatomical, chemical and DNA markers solve the problem by distinguishing the real material from adulterants, substitutes and counterfeit drugs.

Macroscopic examination – involves comparing the morphological characteristics visible to the naked eye or at low magnification

With descriptions of the plant or botanical medicines in the Flora or in monographs. Macroscopic identification typically uses characteristics such as size, shape and color of leaves (or their fragments), flowers And fruits.

Microscopic Examination – Focuses on the anatomical structures of plant material that are only

visible under a microscope. Features such as the shape and structure of the trachoma (hair), the arrangement of the stomata in the epidermis, the presence or absence of compounds such as mucus, starch or lignin

And the presence of tissue with characteristic cells can be used in identification microscopic examination of medicinal plants.

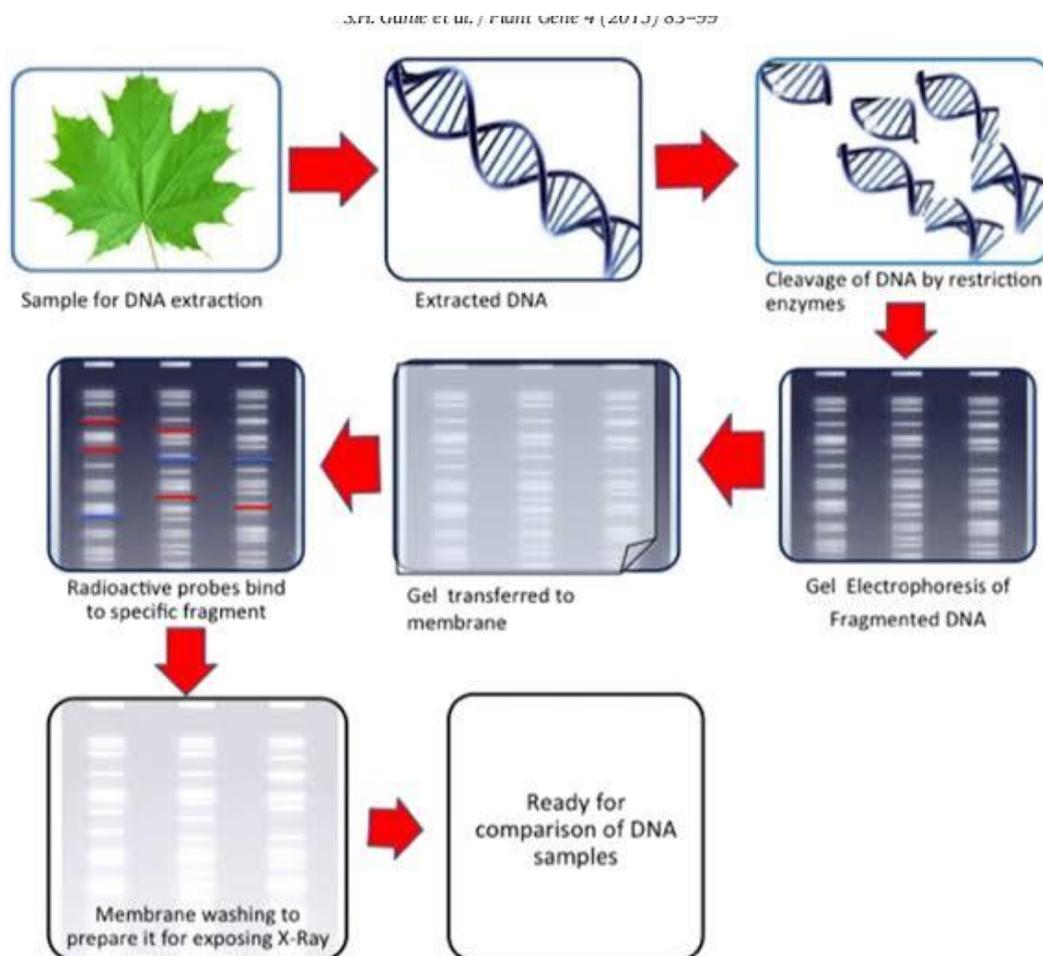


Fig 1 Detailed diagram mechanism of DBE

Chromatography -Chromatography is the separation of chemical compounds in a mixture. There are many chromatographic techniques, but they are all based on the same basic principles. Chromatography means writing in color, and a more specific definition is a physical separation process in which a mixture of compounds can be separated and isolated and purified into different molecules, the rate of distribution of which depends on 1. The solubility and 2. The affinity (whether polar or less) depends. . polar molecules) 3. When interacting with a solid material (stationary phase, which we will define later), the components of the mixture are distributed between two phases, the

stationary phase And the mobile phase, which move at different speeds in a precise direction emotional .

Thin layer Chromatography (TLC)-Thin layer chromatography (TLC) is a chromatographic technique for separating mixtures. Chromatography was discovered by M. Tswett in 1906. Thin layer chromatography is performed on a glass, plastic, or aluminum plate covered with a thin layer of adsorbent material, usually silica gel, aluminum oxide, or cellulose (paper). This adsorption layer is called the stationary phase. Once the sample is applied to the plate, the solvent or solvent mixture (called the mobile phase) is extracted from the plate by capillary action. Because different analytes move

at different speeds on the TLC plate, separation is achieved.

High performance liquid Chromatography (HPLC)-

High -Performance Liquid Chromatography, also Known as High-Pressure Liquid Chromatography, is A type of column Chromatography that is Commonly used in biochemistry and analysis to separate, Identify, and quantify active chemicals. It is a popular Analytical technique for separating, identifying, and Quantifying each element of a mixture.HPLC is a Sophisticated column liquid chromatography technology.The solvent normally flows through the column due to Gravity, but in the HPLC process, the solvent is pushed Under high pressures of up to 400 atmospheres so that the Sample can be separated into

different constituents based On differences in relative affinities.

Different extraction method including advanced extraction technique –

Extraction -Extraction is the first step in separating the desired natural substances from the raw materials. The extraction methods include solvent extraction, distillation method, pressing and sublimation according to the extraction principle. The most commonly used method is solvent extraction. The extraction of natural products occurs according to the following steps: (1) the solvent penetrates into the solid matrix; (2) the solute dissolves in solvents; (3) the solute diffuses from the solid matrix; (4) Extracted solutes are collected. Any agent that increases diffusivity and solubility in the previous steps will facilitate extraction.

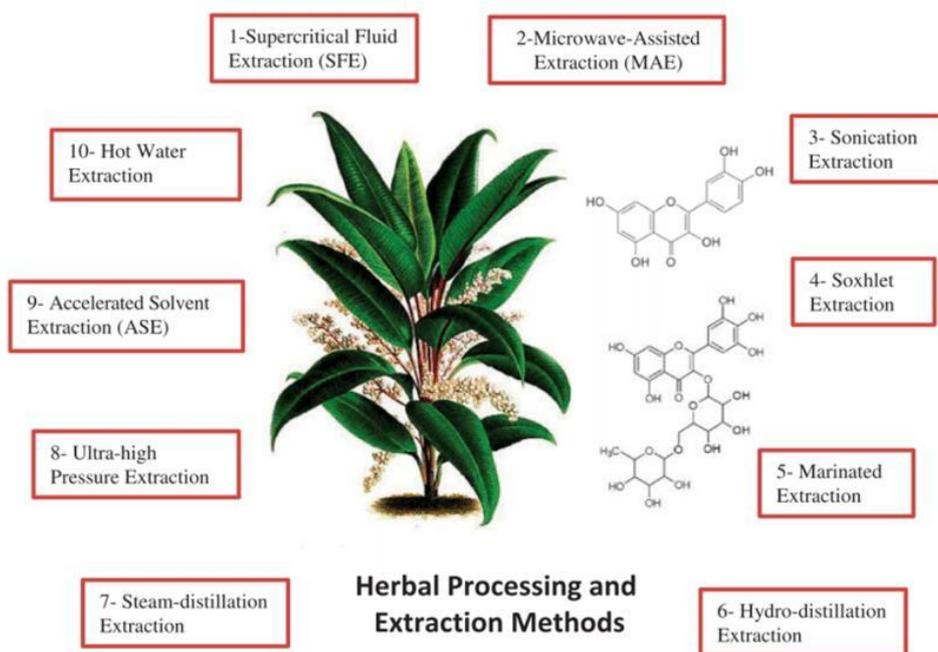


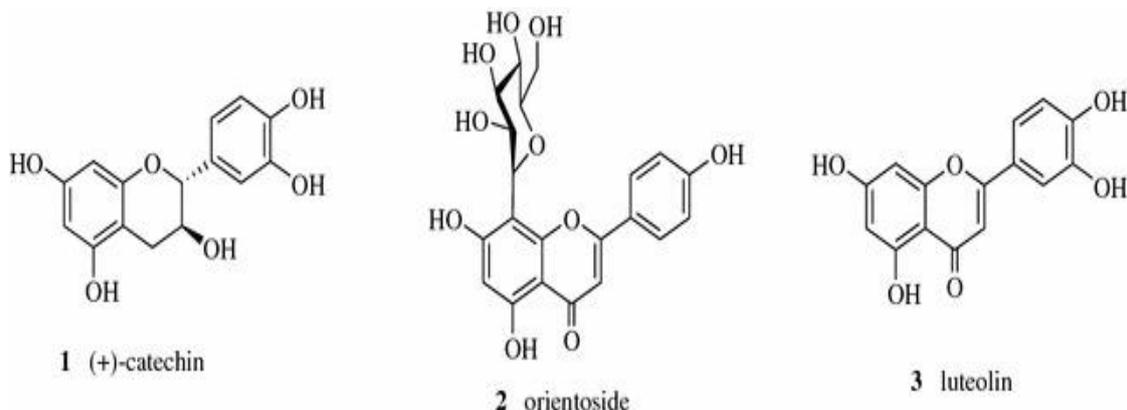
FIGURE 1 The 10 extraction methods described in the text.

1.Maceration -

This is a very simple extraction method, the disadvantage of which is the long extraction time and the low extraction efficiency. It can be used to extract thermolabile ingredients. Judic et al. achieved high yields of total phenols and total anthocyanins from aronia fruits under optimized conditions with 50%

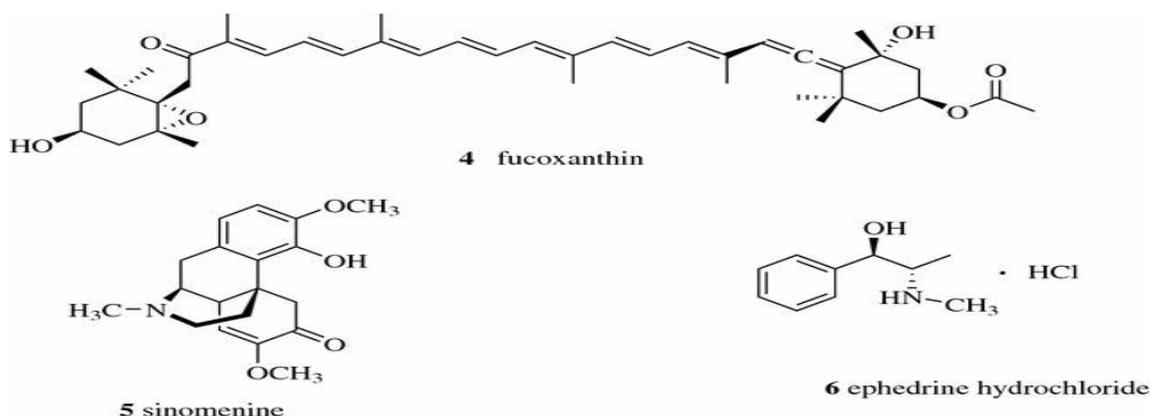
ethanol, a solid/solvent ratio of 1:20, and a particle size of 0.75 mm, suggesting that maceration is a simple and effective method for extracting phenolic compounds from aronia fruits.

The lowest extraction efficiency of orientoside, luteolin and total flavonoids was found in the extract obtained by maceration.



2. percolation -Percolation is more efficient than maceration because it is a continuous process in which saturated solvent is constantly replaced with fresh solvent. Zhang et al. compared percolation and reflux extraction methods for the extraction of *Undaria pinnatifida*. They found that the content of the main component fucoxanthin was higher in the percolation extraction method than in the reflux method, and there was no significant difference in the extract yield between the two methods.

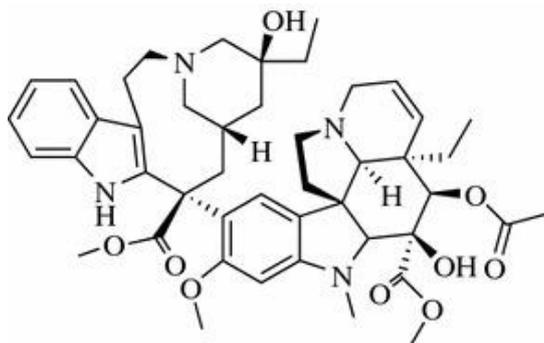
Used the total alkaloid content determined by acid-base titration as an indicator and optimized the ethanol percolation method, in which the drug is immersed in 55% alcohol for 24 hours and then filtered with an amount of alcohol twelve times higher than 55%. Using the extraction rate of sinomenine and ephedrine hydrochloride as an indicator, Gao developed another optimized percolation method: soak the drug in 70% ethanol for 24 hours and then percolate with 20 times more 70% ethanol.



3. Super critical fluid extraction –

Supercritical fluid extraction (SFE) uses a supercritical fluid (SF) as the extraction solvent. SF has similar solubility and diffusivity to gas in liquids and can dissolve a variety of natural products. Their solvation properties changed significantly near the critical points due to small changes in pressure and temperature. Supercritical carbon dioxide (S-CO₂) is

widely used in SFE due to its attractive advantages such as low critical temperature (31 °C), selectivity, inertness, low cost, non-toxicity, and thermally labile extraction capability. Links. The low polarity of S-CO₂ makes it ideal for the extraction of non-polar natural products such as lipids and essential oils. A modifier can be added to S-CO₂ to significantly improve its solvation properties.

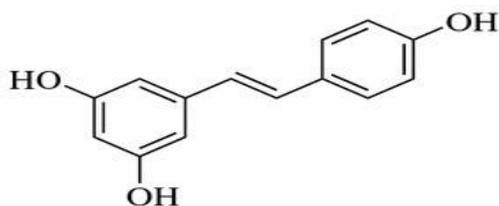


53 vinblastine

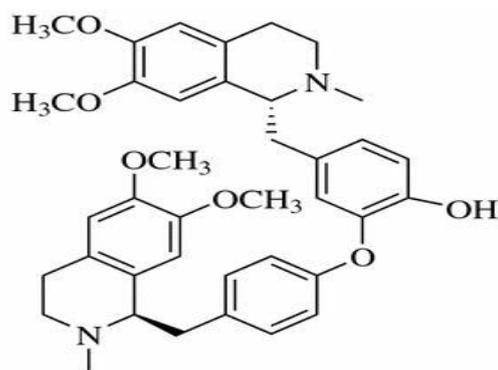
4. Microwave Assisted extraction –

Microwaves generate heat by interacting with polar compounds such as water and some organic components of the plant matrix, according to the mechanisms of ionic conduction and dipolar rotation. Heat and mass transfers occur in the same direction in MAE, creating a synergistic effect that accelerates extraction and improves extraction efficiency. Using MAE offers many advantages such as: B. higher

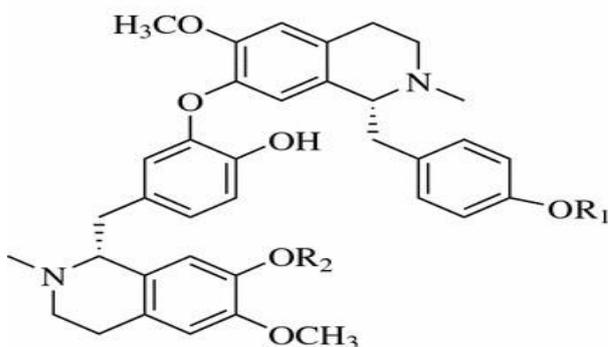
extract yield, reduction in thermal degradation and selective heating of plant material MAE has also been recognized as an environmentally friendly technology because it reduces the use of organic solvents. There are two types of MAE methods: solvent-free extraction (usually for volatile compounds) and solvent extraction (usually for non-volatile compound)



60 *E*-resveratrol



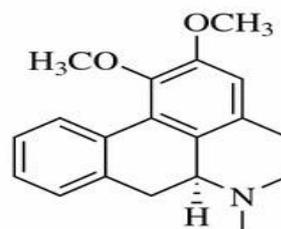
64 dauricine



61 liensinine $R_1=H$ $R_2=CH_3$

62 neferine $R_1=CH_3$ $R_2=CH_3$

63 isoliensinine $R_1=CH_3$ $R_2=H$



65 nuciferin

5. Soxhlet Extraction –

Named after “Franz Ritter von Soxhlet”, a German agricultural chemist, Is the best method for continuous hot solvent extraction of a solid .The Soxhlet device is a special glass reflux unit mainly used for Organic solvent extraction. The solid powdery material is placed in a filter paper sleeve and placed in a Soxhlet apparatus. The apparatus is connected to a flask (RB) Containing the solvent and a reflux condenser. The Solvent in the RB flask slowly boils, the vapor flows through the Side tube, condenses in the radiator and falls into the Sleeve containing the material, slowly filling the Soxhlet.

Once the solvent reaches the top of the connected tube, Withdraws into the vial and removes some of the extracted substance.

6. Decoction –

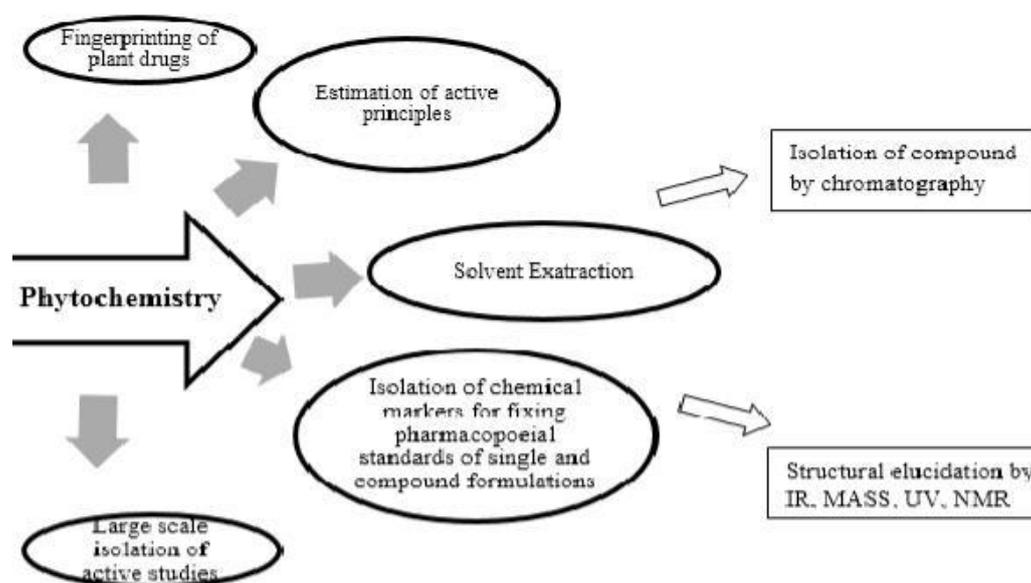
In this process, powdered vegetable raw materials are boiled in a certain amount of water for a certain time; It is then cooled and filtered. This process is suitable for obtaining water-soluble and thermostable components. This process Is commonly used to prepare Ayurvedic extracts Called “Quath” or “Kawath”. First sexual intercourse Raw medicine

and water are mixed, for example 1:4 or 1:16; The volume is And is then reduced to a quarter of the original volume by boiling at During the extraction process. The concentrated extract Is then filtered and used as is or further processed.

7. Solvent Extraction Method –

Solvent extraction is the most common method for extracting plant material. The main goal is to select the appropriate solvent to efficiently extract the target plant materials. During extraction, the solvent must first diffuse into the cell membrane, in the next phase it must dissolve the solutes, then there is a difference in intra- and extracellular concentrations and finally it must diffuse out of the cells enriched with the extracted solutes. then there is a difference in the intracellular and extracellular concentration and finally it must diffuse out of the cells enriched with extracted solutes. They are commonly used to extract chemical components from plants and have a weak to strong polarity as follows: petroleum ether < carbon tetrachloride < Benzene < Dichloromethane < Chloroform < Ether < Ethyl acetate < n-Butanol < Acetone < Ethanol < Methanol < Waterfall.

Isolation technique –



1. partition chromatography –

It is a type of chromatographic process that separates components using different partition coefficients between the stationary phase and the mobile phase, which are immiscible liquids. Partition chromatography can be divided into normal phase

chromatography and reverse phase chromatography. In normal phase partition chromatography, which is mainly used to separate polar and moderately polar molecular compounds, the polarity of the stationary phase is stronger than that of the mobile phase. Media commonly used in normal phase distribution

chromatography include silica gel, diatomaceous earth, cellulose powder, etc. Silica gel with water content above 17% can be used as a support in distribution chromatography due to the adsorption loss. It is the most commonly used partition media

2. Ion Exchange Chromatography –

Chemical components are separated based on the different degrees of dissociation. An ion exchange resin is used as the stationary phase and water or a solvent mixed with water is used as the mobile phase. The ionic components present in the mobile phase are absorbed by the ion exchange resin after the ion exchange reaction. Ion exchange chromatography is suitable for separating ionic compounds such as alkaloids, amino acids, organic acids, peptides and flavonoids. The capacity of the

Ion exchange reaction between compounds and ion exchange resins mainly depends on the degree of dissociation of the compounds and the amount of electrical charges. If the degree of dissociation of a compound is high (acidic or basic), it exchanges easily with resins and is difficult to elute. Therefore, when exchanging compounds with different degrees of dissociation on the resin, compounds with a lower degree of dissociation are eluted before those with a higher degree of dissociation.

3. Adsorption Chromatography –

This is a type of chromatography based on the different adsorption capacity of adsorbents for different compounds. Commonly used adsorbents include silica gel, alumina, activated carbon, polyamide, etc. Silica gel adsorption chromatography is widely used and is suitable for the separation of most plant chemicals. Alumina adsorption chromatography is mainly used for the separation of basic or neutral lipophilic components such as alkaloids, steroids and terpenoids.

Activated carbon is mainly used to separate water-soluble substances such as amino acids, carbohydrates and some types of glycosides. Polyamide, which allows separation based on hydrogen bond formation, is mainly used for the separation of phenols, quinones, flavonoids, anthraquinones, tannins, etc.

4. Gel chromatography -Molecular sieving is the main principle of gel permeation chromatography, which allows the separation of compound mixtures based on the pore size of the gel and the molecular size of the compounds. Gel is a kind of solid material with a porous network structure. The particles of the separated substances are of different sizes and

therefore have different abilities to penetrate the gel. When the mixed solution passes through the gel column, particles smaller than the gel pores can freely enter the gel, while

Molecules larger than the gel pores cannot penetrate the gel and only pass through the gaps in the gel. Particles. That is why different movement speeds occur. Large particles are not excluded and the residence time is shorter. Small particles are retained in the pores by diffusion, which increases the residence time. There are many types of gels on the market, the most common are dextran gel and hydroxypropyl dextran gel.

5. Column chromatography -In chemistry, column chromatography is a chromatographic method for isolating a single chemical compound from a mixture. Chromatography allows the separation of substances based on the differential adsorption of compounds on the adsorbent; The compounds move through the column at different speeds and can thus be separated into fractions. This technique has wide applications because many different adsorbents (normal phase, reverse phase or others) can be used with a wide range of solvents. The

Technique can be applied on scales from micrograms to kilograms. The main advantage of column chromatography is its relatively low cost and the ability to use the stationary phase used in the process. The latter avoids cross-contamination and the degradation of the stationary phase through recycling. Column chromatography can be performed using gravity to move the solvent or using compressed gas to force the solvent through the column.

Purification techniques –

In phytochemical separation, plant extract components or active parts are individually isolated and purified into monomer compounds by physical and chemical methods. Conventional isolation methods, including solvent extraction, precipitation, crystallization, fractional distillation, salting and dialysis, are still widely used. On the other hand, modern separation technologies such as column chromatography, high-performance liquid chromatography,

Ultrafiltration and high-performance liquid drop countercurrent chromatography also play an important role in the separation of phytochemicals. This section describes common methods and their specific applications in the isolation of phytochemicals.

1.polarity gradient and Extraction method –

This method aims to achieve the separation goal based on the different polarity of each component in plant extracts and different partition coefficients in two-phase solvents. Depending on the polarity of the plant extract components, different two-phase solvent systems are generally selected. For example, high polarity components can be separated with the n-butanol-water system, medium polarity components with the ethyl acetate-water system, and low polarity

Components with chloroform (or ether). -Water system. During the operation, the plant extract must first be dissolved in water, then the solution or suspension must be extracted in a separatory funnel with another organic solvent that is immiscible with water due to the difference in polarity. Generally, the extract was first extracted with petroleum ether (or cyclohexane), then with ethyl acetate (or chloroform), and finally with water-saturated n-butanol, as shown in Figure

-1.Petroleum ether layer contains lipid-soluble compounds with low polarity. Ethyl acetate layer contains medium polar compounds such as monoglycosides, flavonoids, and compounds With more polar functional groups. N-butanol layer contains compounds with strong polarity, such as Oligoglycosides and other water-soluble components. Compounds in water layer possess strongest polarity, Such as glycosides with more glycosyl groups, carbohydrates, amino acids, proteins, and other water soluble Compounds.

2. precipitation Method –

This is a method in which certain phytochemicals precipitate by reacting with certain reagents or by precipitating certain components from a solution by adding certain reagents, which can reduce the solubility of certain components in the solution. The precipitation reaction must be reversible if target components are required for precipitation. If the components are not used in a targeted manner, the precipitate produced is eliminated and the precipitation reaction can therefore be irreversible. Depending on the addition of reagents or solvents, this method can be classified as follows. Components of a Mixed Component A solution can be modified so that it can be precipitated from the solution by adding a certain solvent that is mutually soluble in the solution. Gradual precipitation by changing the polarity or the amount of solvent added is called fractional precipitation. For example, when water is used as an extraction solvent to extract phytochemicals, ethanol is added to the

water extraction concentrate to bring the alcohol content above 80%, so the polysaccharides, proteins, starch, gum, etc. it is precipitated and eliminated after filtration. The above process is called water extraction and ethanol precipitation. This method is often used to separate crude polysaccharides From plants.

Standardization of advanced herbal drug -

In recent years, developed countries have experienced strong demand for herbal products. These products are increasingly in demand as pharmaceuticals, nutraceuticals and cosmetics⁴. In order to ensure adequate coordination of the quality of raw materials, processing materials and finished products, it has become necessary to develop reliable, specific and sensitive quality control methods using a combination of classical and modern instrumental analysis methods.

Standardization is an essential measure to ensure the quality control of herbal medicinal products⁵. The standardization of herbal medicines involves defining a set of standards or inherent characteristics, constant parameters and final qualitative and quantitative values that guarantee quality, effectiveness, safety and reproducibility. This is the process of developing and agreeing technical standards. Specific standards are developed through experimentation and observation, resulting in a variety of characteristics of individual drugs being prescribed. Standardization is therefore a tool in the quality control process⁶. The American Herbal Product Association defines: “Standardization refers to all the information and controls necessary to produce a material of reasonable consistency.” This goal has been achieved

By minimizing the variability inherent in the composition of the natural product through quality assurance practices in agricultural and manufacturing processes⁷.

Need of standardization -In ancient times, Vaidya was used to treat patients individually and prepare medicines according to the patient's needs. In almost all systems of traditional medicine, the aspect of quality control is taken into account on the basis of inspection by Rishi, Vaidya and Hakim. Unlike the times when traditional doctors prepared medicinal plants and tested their properties, the problems we face today concern the economics of industrial-scale production, shelf life and long-distance distribution. This necessitated the development of modern and objective standards to assess the safety, quality and effectiveness of these medicines. People are also

becoming aware of its effectiveness and side effects. To gain the public's trust and introduce herbal products into today's healthcare system, researchers, manufacturers and regulators must use rigorous scientific methods to ensure the quality and consistency of traditional herbal products from batch to batch¹¹. The need for quality control and standardization of herbal products can be summarized as follows: 1. When traditional medicines were developed, the technology and concept of standardization were completely different. 2. Over the past ,000 years, the dynamic evolutionary process may have changed the identity of plant material 3. Due to commercialization, supply of genuine raw material has become a challenge. 4. Properties of botanicals may have undergone change due to time and environmental factors¹²

Standardization of poly herbal Formulations –

Standardization is an important aspect in maintaining and evaluating the quality and safety of a multiherbal preparation as it involves combinations of more than one herb to achieve the desired therapeutic effect. Standardization minimizes differences between batches. Ensuring the safety, effectiveness, quality and acceptability of herbal preparations. Standardization of various commercially available herbal and multi-herbal preparations of Madhumehari Churna (Baidynath) containing a mixture of eight herbs.

Dashamularishta, traditional preparation for normalizing physiological processes after the birth of a child. TLC and HPTLC fingerprint profiles were used to determine the identity, purity and potency of the polyherbal preparation and also to set standards for this Ayurvedic preparation.

WHO guidelines for quality standardized herbal formulations –

The topic of standardization of medicinal plants is extremely broad and profound. The guidelines established by WHO

Can be summarized as follows:

- Reference to the identity of the drug
- Reference to the physico-chemical nature of the drug.
- Relation to pharmacological parameters.
- Microbiological parameters
- Radioactive contamination.

1. Drug Identity Reference:

Botanical Evaluation: Botanical Identity, e.g. B. Phytomorphology, microscopic and histological

analysis, sensory properties, organic xenobiotics, histochemical evaluation, etc.

2. Pharmacological properties reference:

Biological activity profile, bitterness index, hemolysis index, astringency, swelling index, foam index, etc.

3. Toxicity information:

Pesticide residues, heavy metals, microbial contamination as a total number of living organisms, pathogens such as E.Coli, Salmonella S. aurea.

4. Microbiological parameter:

Includes the total number of live bacteria, the total number of molds and the total number of enterobacteria. Limiters can be used as a quantitative or semi-quantitative tool to provide safety and control the amount of impurities, such as: B. Reagents used in the extraction of various herbs or contaminants that come directly from production tanks.

II. Conclusion –

This topic mainly focuses on plant extraction techniques. Plants, herbs, and ethnobotanicals have been used since the dawn of humanity and continue to be used throughout the world today to promote health and treat disease. Plants and natural sources form the basis of modern medicine and contribute significantly to the commercial pharmaceutical preparations manufactured today. About 25% of the medicines prescribed worldwide are derived from plants. However, herbs are often used instead of medications in healthcare.

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