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# A comprehensive review on herbal standardisation

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**Abstract**
Nowadays more importance has been given to the use of medicinal plant products in the healthcare system.it fulfills the worldwide need for alternative medicine so traditional systems of medicine become more and more popular. It involves a Proper combination of modern scientific techniques and traditional knowledge. The quality of herbal products is checked through stability testing studies which depend on various factors, such as temperature, humidity, light, oxygen, moisture, other ingredients, microbial contamination, trace metal contamination, leaching from the container, etc. Therefore such studies involve various types of evaluation such as chemical, physical, microbiological, therapeutic, and toxicological studies can serve as an important tool in stability studies. Standardization of herbal drugs means confirmation of their identity, quality, and purity. The present study includes a review of various standardization parameters with their effectivity towards the quality herbal drugs. The present article also overviews various welldesigned methodologies, techniques such as Chromatography, Spectroscopic tech. for the standardisation of herbal raw materials and herbal formulations.

**Keywords:** herbal drug, standardization of herbal formulation, well-designed methodologies, stability studies

## Introduction

### Standardisation of Herbal drug

Standardization of herbal drugs is the process of evaluating the quality and purity of crude drugs by means of various parameters like morphology, physical, chemical, and biological observation [1, 64]. Herbal standardization is a system to ensure that every packet of medicine that is being sold has the correct amount and will induce its therapeutic effect (Chaudhry, 1992)." Standardization of herbal formulations is essential in order to assess quality drugs, based on the concentration of their active principle, physical, chemical, Physico-chemical standardization, and in vitro, in-vivo parameters [2, 65]. Natural products have been our single most successful source of herbal medicines.

### Advantages of herbal drugs

1. Low cost of production.
2. They may have fewer side effects.
3. Effective with chronic conditions.
4. Widespread availability.

### Disadvantages of herbal drugs

1. Lack of dosage instruction.
2. Poison risk associated with wild herbs.
3. Can interact with other drugs.
4. Inappropriate for many conditions.
5. Some are not safe to use.

In this standardization technique, Geographical variation, condition of the soil, substitution, adulteration, and variation of species alter the phytochemical Studies.[3-5]During manufacturing, formulating, storing, packaging, transportation, and distribution of drugs may alter the efficacy, safety, stability so, for genuine practice, standardization of herbal drugs is the need of the era.[6]For standardization Herbal drugs and products, should encompass the entire field of study from the cultivation of medicinal plants to their therapeutic application. Increasing reports of adverse reactions from herbal drugs have drawn the attention of many regulatory agencies for the standardization of herbal formulations.[7]The regulatory authorities rigidly follow various standards of quality prescribed for raw materials and finished products in pharmacopeias, formularies, and manufacturing operation through statutory imposed good manufacturing practices(GMP). To maintain all these things World Health Organization (WHO) has developed drug standardizing parameters [8, 9].

### Standardisations protocol of WHO [9-15]

**Table 1**

| | | |
|---|---|---|
| Botanical parameters | Sensory evaluation | Colour<br>Odour<br>Taste<br>Texture and fracture |
| | Foreign matter | Soil, sands, unnecessary plant parts, insects, etc. |
| | Microscopy | Study of plants tissue (Vascular bundle, parenchyma, collenchyma, sclerenchyma, resin, starch, stone |

### Physiochemical parameters [16-18]

**Table 2**

| Physiochemical parameters: | Objectives |
|---|---|
| Loss on Drying | It determine the volatile and moisture content of the drugs<br>Helps in the prevention of decaying of drugs. |
| Total Ash | It determine the total earthy materials like silica, inorganic and organic impurity present along with authentic drugs |
| Acid Insoluble Ash | |
| Water soluble Ash | |
| Alcohol soluble extractive Value | To estimate the amount of Alcohol soluble phytoconstituents as per standard |
| Water soluble extractive value | To estimate the amount of water soluble phytoconstituents as per standard |

### Pharmacological parameters [16-20]

**Table 3**

| Pharmacological parameters | Objectives |
|---|---|
| Bitterness value | Bitter properties of the plants materials are determined the comparing the threshold bitter concentration of the<br>Materials with that of a dilute solution of quinine HCL. It stimulates the Gastric secretion. |
| Hemolytic Property | Saponin has characteristics of frothing property and has ability to cause hemolysis when added to suspension of blood.<br>The plants from caryophyllaceous, Aralaceae, Sapindaceae, primulaceae contain saponin.<br>It is determined by comparing with reference material saponin which has hemolytic activity in 1000 unit per gram. |
| Astringent property | Tannins are present in the cell sap. It has astringent property. Tannin binds with proteins and turns into water<br>insoluble materials and are resist to proteolytic enzymes |
| Swelling index | Some medicinal plants have therapeutic effect due to their swelling property.<br>The swelling index is the volume in ml taken up by the swelling of 1gm of plants materials under specified condition. |
| Foaming index | Saponins are high molecular weight containing phytoconstituents having detergent activity.<br>The foaming ability of an aqueous decoction of plant materials is measured in term of foaming index. |

### Toxicological parameters [21, 22, 24]

**Table 4**

| Toxicological parameters | Objectives |
|---|---|
| Arsenic | Arsenic is danger for health even in trace amount. They have to remove from drugs. |
| Pesticide residues | Organochlorine, Organophosphorus carbamet and triazine are major pesticides present in crude drugs which<br>are danger for CNS, Cardiovascular and respiratory system. |
| Heavy metals | Metal having high atomic Number, densities and atomic weight i.e. Cadmium, Mercury, Lead are highly toxic to<br>Liver and Kidney. |
| Microbial contamination | Determination of total aerobic microbial count, total fungal count, total Entero-bacteriaceae count, test for the presence of E. Coli, Staphylococcus aureus, shigella, pseudomonas aeruginosa, and Salmonella. |
| Aflatoxins | Toxin produced by the Staphylococcus aureus which cause hemolysis and tissue damage |
| Radioactive contamination | The radioactive substance like Uranium produces the radiation which is mutagenic and carcinogenic. |

### Chromatographic technique [25-27]

**Table 5**

| Thin layer Chromatography (TLC) | Quantification of chemical constituents |
|---|---|
| High performance Thin Chromatography (HPTLC) | Qualitative and quantitative evaluation of phytoconstituents, Identification and detection of adulterants, pesticide content, mycotoxins. |
| High performance Liquid Chromatography (HPLC) | Quantitative and qualitative evaluation of phytoconstituents |
| Liquid Chromatography Mass Spectrometry (LC-MS) | Accurate determination of molecular weight of proteins, peptides. Isotopes pattern can be<br>Detected |
| Gas Chromatography Mass Spectrometry (GC-MS) | Analysis of volatile constituents, Qualitative analysis of the complex constituents. |
| Liquid Chromatography-Nuclear Magnetic Resonance (LC-NMR) | Useful in the areas of pharmacokinetics, toxicity studies, drug metabolism and drug<br>Discovery process. |
| Supercritical Fluid Chromatography (SFC) | SFC permits the separation and determination of a group of compounds that are not conveniently handled by either gas or liquid chromatography. |

### Need of Standardisation

In recent years there is a spurt in the interest regarding the survival of herbal forms of medication. As the dangers and the shortcoming of modern medicine have got more apparent, the majority of Ayurvedic formulations are prepared from herbs [28]. It is the cardinal responsibility of the regulatory authorities to ensure that the consumers get the medication, which guarantees. Purity, safety, potency, and efficacy. World health organization (WHO) has emphasized the need to ensure quality control of medicinal plant products by using modern techniques and by applying suitable standardisation parameters and standards [29].

**Need of Quality control and standardization of herbal products can be summarized as follows**

1. When traditional medicines were developed technology and the concept of standardization were quite different.
2. During the past thousand years, the dynamic process of evolution may have changed the identity of plant material.
3. Due to commercialization, the supply of genuine raw material has become a challenge.
4. Properties of botanicals may have undergone change due to time and environmental factors [64].

**Method of standardization** [25]

According to WHO (1996a and b, 1992), standardization and quality control of herbals is the process involved in the physicochemical evaluation of crude drug covering aspects, such as selection and handling of crude material, safety, efficacy and stability assessment of finished product, documentation of safety and risk based on experience, provision of product information to consumer and product promotion. Attention is normally paid to such quality indices such as:

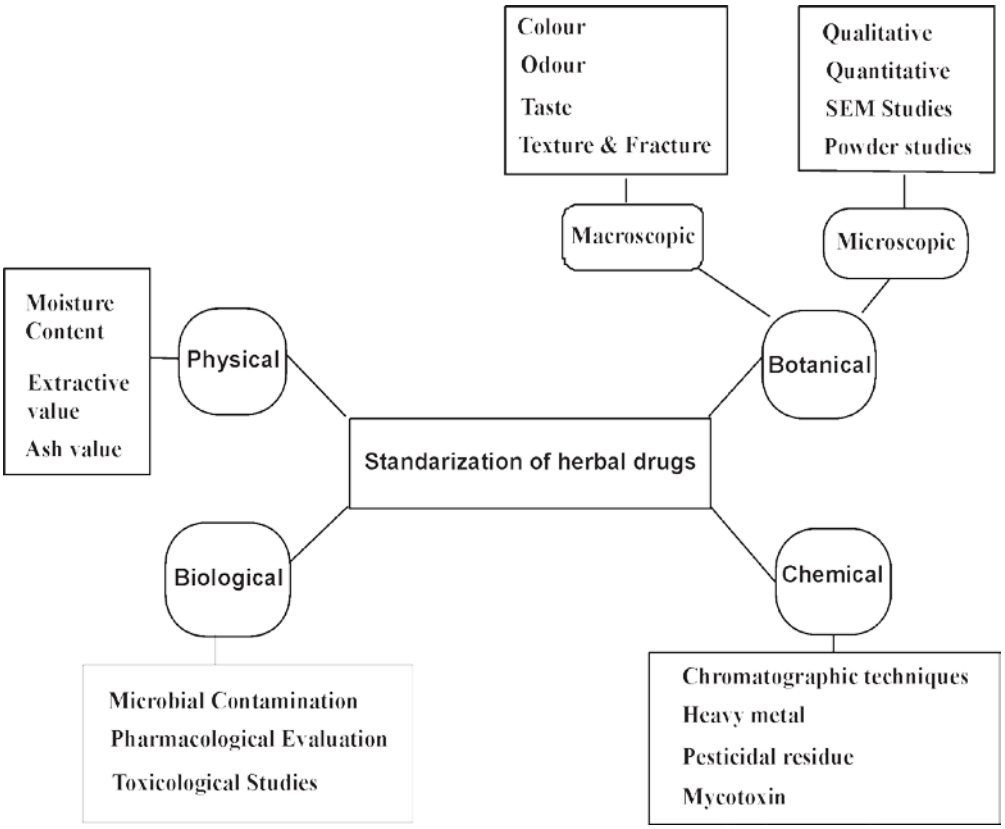


**Fig 1:** A schematic representation of herbal drug standardization

**Macro and microscopic examination**

In this examination to identify the right variety and search of adulterants.

**Foreign organic matter**

This study is to carry out the removal of matter other than the source plant to get the drug in pure form.

**Ash values**

Ash values are criteria to judge the identity and purity of crude drugs – Total ash, sulphated ash, water soluble ash and acid insoluble ash etc.

**Moisture content**

Check the moisture content helps reduce errors in the estimation of the actual weight of drug material. Low moisture helpful better stability against degradation of the product help.

**Extractive values**

This study is to carry out indicative weights of the extractable chemical constituents of the crude drugs under different solvents environment.

**Crude fiber**

This study is to carry out help to determine the woody material component, and it is a criterion for judging purity.

**Qualitative chemical evaluation**

Herbal standardisation covers the identification and characterization of crude drugs with respect to phytochemical constituents. It employs different analytical methods to detect and isolate the active constituents. Phytochemical studies involve botanical identification, extraction with suitable solvents, purification, and characterization of the active constituents of pharmaceutical importance.

**Chromatographic examination:**

Identifying crude drugs based on the use of major chemical constituents as markers is helpful in standardisation process.

**Quantitative chemical evaluation:**

In quantitative study to estimate the amount of the major classes of constituents.

**Toxicological studies**

The toxicological study helps to determine the pesticide residues, potentially toxic elements, safety studies in animals like LD50, and Microbial assay to establish the absence or presence of potentially harmful microorganisms. The processes mentioned above involves a wide array of scientific investigations, which include physical, chemical, and biological evaluation employing various analytical methods and tools.

**Morphological or Organoleptic Evaluation:**

Organoleptic evaluation of herbal drugs by size, shape colour, odour, taste and particular characteristics like touch, texture etc. This technique of qualitative evaluation is related to the study of the morphological and sensory reports of whole drugs. Morphological evaluation examples are Fractured surfaces in cascara, cinchona, and quillia bark, and quassia wood is important characteristics in this morphological evaluation. Umbelliferous fruits have an aromatic odour and liquorice have sweet taste are the example of this Morphological evaluation. In this evaluation shape of the drug may be conical (aconite), subcylindrical (podophyllum), cylindrical (sarsapilla), fusi form (jalap). Size represents thickness, length, breadth and diameter. Colour represents external colour which varies from white to brownish-black is essential diagnostic features in these organoleptic characteristics. The taste is a specific type of sensation feel by the epithelial layer of the tongue. Organoleptic characteristics he tastes may be sweetish (saccharic), sour (acidic), salt-like (saline), and bitter or tasteless [35, 36, 37].

**Microscopic evaluation**

It involves detailed examination of the drugs and it can be used to identify the organized drugs by their known histological characters. It is mostly used for qualitative evaluation of organized crude drugs in entire and power forms with help of microscopic. Using microscope detecting various cellular tissues, trichomes, stomata, starch granules, calcium oxalate crystals and aleuronic grains are some of important parameters which play important role in identification of certain crude drugs standardization Starch and hemicelluloses is identified by blue color with iodine solution, All lignified tissues give pink strain with phloroglucinol and HCl etc. mucilage is stained pink with ruthenium red can be used to distinguish cellular structure. Microscopic evaluation also includes study of constituents in the powdered drug by the use of chemical reagents. Quantitative aspects of microscopy includes study of stomata number and index, palisade ratio, vein-islet number, size of starch grains, length of fibers etc. which plays a very important role in the identification of drug[65].

**Chemical evaluation**

Most herbal drugs have definite chemical constituents to which their biological or pharmacological activity is attributed. Qualitative chemical tests are used to identify certain herbal drugs or to test their purity. Isolation, purification, identification of active constituents is based on methods of chemical evaluation.

- Evaluation test of resins: acid value, sulphated ash, etc
- Evaluation test of balsams: acid value, saponification values.
- Evaluation test of volatile oils: acetyl and ester values etc.
- The qualitative chemical tests are useful in the identification of chemical constituents and detection of adulteration [31-34].

**Physical Evaluation**

Each monograph contains herbal standardisation with detailed botanical, macroscopic, and microscopic descriptions with detailed illustrations and photographic images which provide visual documentation of accurately identified drug material. A microscopic analysis is important for the identity of the material and as an initial screening test for impurities [38, 39].

**Determination of ash**

The ash remaining following ignition of medicinal plant materials is determined by three different methods which measure total ash, acid-insoluble ash, and water-soluble ash in this standardisation process. It is designed to measure the total amount of material remaining after ignition in this total ash method. This includes both "physiological ash", which is derived from the plant tissue itself, and "non-physiological" ash, which is the residue of the extraneous matter adhering to the plant surface. Acid-insoluble ash is the residue obtained after boiling the total ash with dilute hydrochloric acid and igniting the remaining insoluble matter. This measures the amount of silica present, especially sand and siliceous earth. Water-soluble ash is the difference in weight between the total ash and the residue after-treatment of the total ash with water [65].

**Determination of extractable matter**

This method determines the number of active constituents extracted with solvents from a given amount of medicinal plant material [40].

1. Water Soluble extractives
2. Alcohol Soluble extractives
3. Ether Soluble extractives

**Determination of Foreign Matter**:

Herbal drugs should be prepared from the confirmed part of the plant. They should be totally free from insects or moulds, including visible and excreta contaminant such as stones, sand, harmful and poisonous foreign matter and chemical residues. Animal objects such as insects and invisible microbial contaminants, which produces toxins, as well as the potential contaminants of herbal medicines. Macroscopic evaluation can easily use to determine the presence of foreign matter, although microscopy is essential in certain special cases for example starch intentionally added to "dilute" the plant material.[41, 42, and 67]

% of Foreign Organic Matter = $N \times W \times 94{,}100 \times 100/S \times M \times P$

Where; n = No. of chart particles in 25 field
S = No. of spores in the same area of 25 fields
W = Weight in mg of lycopodium taken
M= weight in mg of the sample
P= number of characteristics particles per mg of the pure foreign matter
94,000= number of spores per mg of lycopodium

**Biological evaluation**

Some drugs have a specific biological and pharmacological activity that is utilized for their evaluation. Actually, this activity is due to specific types of constituents present in the plant extract. The experiments were carried out on both intact and isolated organs of living animals in this biological evaluation. With the help of bioassays, the strength of the drug in its preparation can be evaluated [31-34].

**Analytical methods**

In this monograph standard is the need for appropriate analytical methods for determining identity, quality, and relative potency. There are so many analytical methods available. However, it is often difficult to know which is the most appropriate to use, but critical among know analytical tools in monograph herbal standardization is chromatography.

**Chromatography**

Chromatography is the science which studies the separation of molecules based on differences in their structure and/or composition. In general, chromatography involves moving a preparation of the materials to be separated, "the "test preparation", over a stationary support. The molecules in the test preparation will have different interactions with the stationary support leading to separation of similar molecules. Test molecules which display tighter interactions with the support will tend to move more slowly through the support than those molecules with weaker interactions. In this way, different types of molecules can be separated from each other as they move over the support material. Chromatographic separations can be carried out using a variety of supports, including immobilized silica on glass plates (thin layer chromatography), very sensitive High Performance Thin Layer Chromatography (HPTLC), volatile gases (gas chromatography), paper (paper chromatography), and liquids which may incorporate hydrophilic, insoluble molecules (liquid chromatography). High performance thin layer chromatography (HPTLC) is a valuable quality assessment tool for the evaluation of botanical materials. It allows for the analysis of a broad number of compounds both efficiently and cost effectively. Additionally, numerous samples can be run in a single analysis thereby dramatically reducing analytical time. With HPTLC, the same analysis can be viewed collectively in different wavelengths of light thereby providing a more complete profile of the plant than is typically observed with more specific type of analysis [68].

**TLC**

Thin-layer chromatography is simply known as TLC. It is one of the most popular and simple chromatographic techniques used for the separation of compounds. In the phytochemical evaluation of herbal drugs, TLC is being employed extensively for the following reasons:

1. This analytical technique enables rapid analysis of herbal extracts with minimum sample clean-up requirement,
2. Chromatographic technique (TLC) provides qualitative and semi-quantitative information of the resolved compounds.
3. It enables the quantification of chemical constituents.

It has a potential application in the identification of an authentic drug, in excluding the adulterants, and in maintaining the quality and consistency of the drug. HPLC fingerprinting includes a recording of the chromatograms, retention time of individual peaks, and the absorption spectra (recorded with a photodiode array detector) with different mobile phases. Similarly, Gas-liquid chromatography is used for generating the fingerprint profiles of volatile oils and fixed oils of herbal drugs. Furthermore, the recent approaches of applying hyphenated chromatography and spectrometry such as High-Performance Liquid Chromatography Diode Array Detection (HPLC–DAD), Gas Chromatography–Mass Spectroscopy (GC–MS), Capillary Electrophoresis - Diode Array Detection (CEDAD), High - Performance Liquid Chromatography-Mass Spectroscopy (HPLC–MS) and High-performance Liquid Chromatography-Nuclear Magnetic Resonance Spectroscopy (HPLC–NMR) could provide the additional spectral information, which will be very helpful for the qualitative analysis and even for the on- line structural elucidation [21, 43].

**HPTLC**

HPTLC technique is widely employed in pharmaceutical industry in process development, identification and detection of adulterants in herbal product and helps in identification of pesticide content, mycotoxins and in quality control of herbs and health foods.[44] It has been well reported that several samples can be run simultaneously by use of a smaller quantity of mobile phase than in HPLC.[45] It has also been reported that mobile phases of pH 8 and above can be used for HPTLC. Another advantage of HPTLC is the repeated detection (scanning) of the chromatogram with the same or different conditions. Consequently, HPTLC has been investigated for simultaneous assay of several components in a multi-component formulation.[46] with this technique, authentication of various species of plant possible, as well as the evaluation of stability and consistency of their preparations from different manufactures. Various workers have developed HPTLC method for phytoconstituents in crude drugs or herbal formulations such as bergenin, catechine and gallic acid in Bergenia cilliata and Bergenia lingulata [47].

**Liquid Chromatography-Mass Spectroscopy**

(LC-MS) LC-MS has become the method of choice in many stages of drug development. Recent advances include electrospray, thermospray, and ionspray ionization techniques which offer unique advantages of high detection sensitivity and specificity, liquid secondary ion mass spectroscopy; later laser mass spectroscopy with 600 MHz offers an accurate determination of molecular weight proteins, peptides. Isotopes pattern can be detected by this technique [48].

**Supercritical Fluid Chromatography (SFC)**

Supercritical fluid chromatography is a hybrid of gas and liquid chromatography that combines some of the best features of each. SFC permits the separation and determination of a group of compounds that are not conveniently handled by either gas or liquid chromatography. SFC has been applied to a wide variety of materials including natural products, drugs, food and pesticide. (Matthew *et al*., 2006). These compounds are either nonvolatile or thermally labile so that GC procedures are inapplicable or contain no functional group that makes

possible detection by the spectroscopic or electrochemical technique employed in LC [49].

**Recent Standardization technique**

**DNA Finger Printing [51]**

DNA technique is useful for the identification of phytochemically indistinguishable genuine drugs from substituted or adulterated drugs. It has been reported that the DNA fingerprint genome remains the same irrespective of the plant part used while the phytochemical content will vary with the plant part used, physiology, and environment, and other conditions. It useful application of DNA fingerprinting is the availability of intact genomic DNA specificity in commercial herbal drugs which helps in distinguishing adulterants even in processed samples. DNA markers in this standardization process are helpful to identify cells, individuals, or species as they can be used to produce normal functioning proteins to replace defective ones. DNA markers help in the treatment of various diseases and help in distinguishing the genuine herb from the adulterated drugs [67].

**Capillary electrophoresis**

The methodology of Capillary electrophoresis was established to evaluate one herb-drug in terms of specificity, sensitivity, and precision, and the results were in agreement with those obtained by the HPLC method. Eg: A characteristic fingerprint of Flos carthami established using Capillary electrophoresis: identifying the raw herb, helping distinguish the substitute or adulterant and further assessing the differences of Flos carthami grown in various areas of China [52, 66].

**Differential Scanning Calorimeter (DSC)**

DSC is an important technique for measuring the energy necessary to establish a nearly zero temperature difference between a sample and reference substances. DSC is a heat based analytical method used to study the thermal response of the specimen sample.

**Application**

- Concentration measurement
- Detection of Impurities
- Structure elucidation of Organic compounds
- Chemical kinetics
- Detection of functional groups
- Molecular weight determination [53, 66]

**Role of genetic marker in herbal drug technology**

**Genetic variation/genotyping**

It has been well documented that geographical conditions affect the active constituents of the medicinal plant and hence their activity profiles. Many researchers have studied geographical variation at the genetic level. Estimates of genetic diversity are also important in designing crop improvement programmes for management of germ plasm and evolving conservation strategies. RAPD-based molecular markers have been found to be useful in differentiating different accessions of neem collected from different geographical regions (Khanuja, 2002).Germplasm analysis to study genetic diversity is another important area in which a lot of efforts have been put in. Fingerprinting of crops like rice wheat, chickpea, pigeon pea, pearl millet etc. is being carried out extensively (Khanuja, 2002; Ramakrishna *et al*., 1994)

**Authentication of medicinal plants**

DNA-based techniques have been widely used for authentication of plant species of medicinal importance. This is especially useful in case of those that are frequently substituted or adulterated with other species or varieties that are morphologically and/or phytochemically indistinguishable (Srivastava *et al*., 2009). Dried fruit samples of Lyciumbarbarum were differentiated from its related species using RAPD markers. The RAPD technique has also been used for determining the components of a Chinese herbal prescription, yu-pingfeng san. In this study the presence of three herbs (Astragalusmembanaceus (Fisch.) Bge, Ledebouriellaseseloides Wolff and Atractylodesmacrocephala Koidz) in the formulation have been detected using a single RAPD primer [65].

**WHO Guidelines for Quality of Herbal Formulation**

1. Quality control of crude drugs material, plant preparations, and finished products in this herbal formulation [54].
2. Stability assessment and shelf life [55].
3. Safety assessment; documentation of safety based on experience or toxicological studies in this herbal formulation [56].
4. Assessment of efficacy by ethnomedical information and biological activity evaluations [57].
5. The bioactive extract should be standardized herbal drug on the basis of active principles or major compounds along with the chromatographic fingerprints (TLC, HPTLC, HPLC, and GC). Generally, all medicines, whether they are synthetic or of plant origin, should fulfil the basic requirement of being safe and effective [58]. The term 'herbal drugs' denotes plants or plant parts that have been converted into phytopharmaceuticals by means of simple processes involving harvesting, drying and storage [59, 69].

**Stability Testing of Herbal Products**

**Analytical Methods for Herbal Products**

The analysis of herbal preparations is mostly done by running high-performance liquid chromatography (HPLC) [60] or gas chromatography (GC) and thin-layer chromatography (TLC) methods, quantitative determinations by UV visible spectroscopy or combinations of these. HPLC and GC are analytical methods can be used for identification and purity testing, as well as the detection of single compounds for assay, is possible during one analysis. LC and GC mass coupling [61] are also tools for determination but, they are highly sophisticated and expensive methods.

**Shelf-Life**

The determination of shelf life of herbal medicinal drug products is the same as chemically defined Active Pharmaceutical ingredient, but the special nature of the herbal product should be taken into consideration. It is recommended that in the case of a herbal medicinal product containing a natural product or a herbal drug preparation with constituents of known therapeutic activity, the variation in the component during the proposed shelf-life should not exceed ± 5% [62, 63] of the initial assay value unless justified to widen the range up to ±10 percent or even higher. In this shelf-life, the low marker concentration in the finished product, justify the wider range. Additionally, due

to the influences of climate, harvesting, and biological variance, the natural variation of the marker content needs to be taken into account. For example, the linearity of the method may be tested over a range of 40-160 percent of the marker's expected content in the extract and/or product. During stability testing, a setting up of the limits to ±10 percent is accepted for the finished product, by the justification of matrix effects (placebo), the lack of precision and selectivity (combination products), and the low analyte concentrations. Considering that the marker content cannot be defined to a specified level, the relative changes from the starting value are specified (95-105 percent or 90-110 percent 'from the initial value) [67].

## Conclusion

The Indian herbal industry is growing in a tremendous rate. More number of herbal products is arrived in the market. The safety and efficacy of herbal products are dependent upon the standardization of these herbal drugs. The traditional approach towards standardization is insufficient for current herbal market and hence there is need for more advanced techniques for standardization. The quality of herbal drugs is the sum of all factors which contribute directly or indirectly to the safety, effectiveness and acceptability of the product. Due to advancement in the chemical knowledge of crude drugs various methods like botanical, chemical, spectroscopic and biological methods are used for estimating active constituents present in the crude drugs. Standardization methods should take into consideration all aspects contributing to the quality of the herbal drugs. The development of modern analytical tools in testing the various quality parameters for an effective quality control herbal product cannot be over emphasized. The assurance of the safety and efficacy of an herbal drug requires monitoring of the quality of the product from collection through processing to the finished packaged product. It is recommended that various government agencies should follow a more universal approach to herbal quality by adopting the WHO guidelines and also developing monographs using the various quality parameters outlined above. This will strengthen the regulatory process and minimize quality breach.

## References


1. Peter AGM & De Smet, Herba remedies. New Eng J Med, 2002, 2046-2056.
2. Hong-Fang Ji, Xue-Juan Li. Hong-Yu Zhang, Natural products and drug discovery, European Molecular Biology Organization, 2009, 10(3).
3. Sagar Bhanu PS, Zafar R, Panwar R. Herbal drug standardization. The Indian Pharmacist,2005:4(35):19-22:16.
4. Amit J, Sunil C, Vimal K, Anupam P. Phytosomes: A revolution in herbal drugs. The Pharma Review,2007:11-13:17.
5. Fraenkel GS. The raison d'ĕtre of secondary plant substances; these odd chemicals arose as a means of protecting plants from insects and now guide insects to food. Science,1959:129(3361):1466-70.
6. Patel PM, Patel NM, Goyal RK. Quality control of herbal products. The Indian Pharmacist,2006:5(45):26-30.
7. Satheesh Madhav NV, Kumud Upadhyaya, Bisht A. Phytochemical screening and standardization of polyherbal formulation for dyslipidemia. Int J Pharm Pharmaceut Sci,2011;3:56-59.
8. Vaidya ADB, Devasagayam TPA. Current status of herbal drugs in India: An overview. J Clin Biochem,2007:41(1):1-11. 20.
9. Bhairam, Monika *et al*. Standardization of herbal medicines - an overview. Journal of Applied Pharmaceutical Research,2013:1(1):14-21.
10. Yadav NP, Dixit VK. Recent approaches in herbal drug standardization. Int J Integr Biol,2008:2:195-203.
11. Sachan V, Kohli Y, Gautam R. Regulatory issues for herbal products – a review. Pharmainfo.net,12/16/2009;http://www.phar mainfo.net/just Vishal/publications/regulator yissues-herbal-products-review.
12. O'Shea TJ .Capillary electrophoresis/electrochemistry. Curr,1995:14(1):18-23.
13. Svicekova M, Havranek E, Novak V. Determination of heavy metals in samples of herbal drugs using differential pulse polarography. J Pharm Biol,1993:42(2):68-70.
14. Anonymous: National Health Policy. New Delhi: Ministry of Health and Family Welfare, Government of India, 1983, 26. apps.who.int/medicinedocs/documents/s148 78e/s14878e.pdf
15. Pattanayak P, Behera M, Mohapatra P, Panda SK. Standardization and evaluation of laxative activity of a polyherbal formulation. Der Pharmacia Lettre,2011:3(1):276-286.
16. Kong WJ, Zhao YL, Xiao XH *et al*. Quantitative and chemical fingerprint analysis for quality control of Rhizoma Coptidischinensis based on UPLC-PAD combined with chemometrics methods, Phytomedicine,2009:16:950-959.
17. Kaur AD, Ravichandran V, Jain PK *et al*. High-performance thin layer chromatography method for estimation of conessine in herbal extract and pharmaceutical dosage formulations, J. Pharm. Biomed. Anal,2008:46:391-394.
18. Apers S, Naessens T, Pieters L *et al*. Densitometric thin-layer chromatographic determination of aescin in a herbal medicinal product containing Aesculus and Vitis dry extracts, J. Chromatogr A,2006:1112:165-170.
19. Marchand E, Atemnkeng MA, Vanermen S. *et al*. Development and validation of a simple thin layer chromatographic method for the analysis of artemisinin in Artemisia annua L. plant extracts, Biomed. Chromatogr,2007:22:454–459.
20. Ray A, Gulati K. Recent advances in herbal drug research and therapy. I K International, 2010, 23-25.
21. Liang YZ, Xie P, Chan KC. Quality control of herbal medicines, J. Chromatogr. B,2004:812:53-70.
22. Agarwal SS, Paridhavi M. Herbal drug technology, Universities Press India Pvt Ltd, 2007, 23.
23. Zafar R, Panwar R, Sagar Bhanu PS. Herbal drug standardization: The Indian Pharmacist,2005:4(36):21-25.
24. Patra KC, Pareta SK, Harwansh RK, Jayaram Kumar K .Traditional approaches towards standardization of herbal medicines -Areview. J Pharm Sci Technol,2010:2(11):372-379.
25. Patwardhan B, Warude D, Pushpangadan P, Bhatt N. Ayurveda and traditional Chinese medicine: A

comparative overview. Evidence-Based Complementary and Alternative Medicine (eCAM),2005:2(4):465-473.
26. Vijaya Kumar D, Raghavan KV. Novel chromatographic fingerprinting method for standardization of single medicines and formulations. Indian Institute of Chemical Technology, Hyderabad, WO 0246739-EP2 0000991 991- 263397CSIR G01N30-88, 2002.
27. Vedantam Giridhar. Quality control of herbal drugs through UV-Vis spectrophotometric analysis, International Journal of Ayurvedic Medicine,2015:6(1):102-109. Supplement,
28. Waxler-Morrison NE. Plural medicine in India and Sri Lanka: do ayurvedic and Western medical practices differ? Soc. Sci.Med,1988:27:531-544.
29. General guidelines for methodologies on research and evaluation of traditional medicine. Geneva, World Health Organization, 2000. (WHO/EDM/TRM/2000.1)
30. Patwardhan B. Ayurveda the designer medicine: a review of ethnopharmacology and bioprospective research. Indian Drugs,2000:37(5):2046-56.
31. WHO. Quality Control Methods for Medicinal Plant Materials. World organization, Genava, 1992.
32. Eisenberg DM, kesseler RC, Foster C, norlock FE, Calkins DR, Delbanco TL. Unconventional medicine in the United States. Prevalence, costs and patterns of use, 1993.
33. Blumenthal M, Brusse WR, Goldberg A, Gruenwald J, Hall T, Riggins CW, Rister RS. The complete german commission E monographs. Therapeutic guide to herbal medicines, the American botanical counsil, Austin, TX, 1998.
34. Brain KR, Turner TD. Practical Evaluation of phytopharmaceuticals. Wright Scientechnica Bristol, 1975.
35. Kokate CK, Gokhale SB and Purohit AP: Pharmacognosy, Nirali Prakashan, Pune, 2010:I:II.
36. Ansari SH. Essentials of Pharmacognosy, Birla Publications Pvt Ltd, 2011.
37. Gupta MK, Sharma PK. Test Book of Pharmacognosy, Ayurvedic formulations, Pragati Prakashan Meerut Vol II, I st edition, 2007.
38. The United States Pharmacopoeia and National Formulary, USP 25 NF 19/National Formulary 20, Rockville, MD, U. S. Pharmacopoeial Convention, Inc, 2002.
39. Pharmacopoeia of the People's Republic of China, English ed., The Pharmacopoeia Commission of PRC, Beijing, 2000.
40. Indian Pharmacopoeia,2010:1:198-201.
41. Organization, Geneva, Archana Gautam. Identification, evaluation and standardization of herbal drugs: A review, Der Pharmacia Lettre,2010:2(6):302-315.
42. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.
43. Ong ES: Chemical assay of glycyrrhizin in medicinal plants by pressurized liquid extraction (PLE) with capillary zone electrophoresis (CZE). J Sep Sci,2002:25:825-831.
44. Soni K, Naved T. HPTLC- Its applications in herbal drug industry. The Pharma Review, 2010, 112-117.
45. Jianga Y, David B, Tu P, Barbin Y. Recent analytical approaches in quality control of traditional Chinese medicines-A review, Anal. Chim. Acta,2010:657:9-18.
46. Thoppil SO, Cardoza RM, and Amin PD: Stability indicating HPTLC determination of Trimetazidine as bulk drug and in pharmaceutical formulations, J. Pharm. Biomed. Anal,20011:25(1):5-20.
47. Dhalwal K, Sindhe VM, Biradar YS, Mahadik KR. Simultaneous quantification of bergenin, catechine, and gallic acid from Bergenia ciliate and Bergenia lingulata by using thin-layer chromatography, J. Food. Comp. Anal,2008:21:496-500.
48. Mike Lee S, Edward Kerns H. LC/MS applications in drug development. Milestone Development Services, Pennington, New Jersey, 1999.
49. Bhutani KK. Herbal medicines enigma and a challenge for science and guidelines for new initiatives. J Nat Prod,2003:19(1):3-8.
50. Patil PS, Rajani S. An advancement of analytical techniques in herbal research. J Adv Sci Res,2010:1(1):8-14.
51. Westman AL, Kresovich S. Use of molecular marker techniques for description of plant genetic variation. In: Biotechnology and plant genetic resources [edited by Callow, J.A.; Ford-Lloyd, B.V.; Newbury, H.J.]. Wallingford, UK: CAB International, 1997, 9-48.
52. Merike Vaher, Mihkel Koel S. eparation of polyphenolic compounds extracted from plant matrices using capillary electrophoresis Journal of Chromatography A,2003:990:225-230.
53. Yacine Boumrah. Analysis of synthetic drugs by differential scanning calorimetry Case of amphetamine-type stimulants (ATS), Journal of Thermal Analysis and Calorimetry, 2015.
54. Kokate CK, Purohit AP, Gokhale SB. "Analytical Pharmacognosy", Nirali publication, 30th edition, 2005, 199.
55. Nikam Pravin H, Kareparamban, Jadhav Aruna & Kadam Vilasrao. Future Trend in Standardization of Herbal Drugs, J of Applied pharmaceutical Sci,2012:2(6):38-44
56. Wani MS, Herbal Medicine and its Standarization. Pharma info,2007:5(6):1-6.
57. Patwardhan B. Ayurveda the designer medicine: a review of ethnopharmacology and bioprospective research. Indian Drugs,2000:37(5):2046-56.
58. Dixit VK, Yadav NP. Recent approaches in herbal drug standardization. Integr Biol,2008:2(3):195-203.
59. Anna KD, Stephen PM. Safety issues in herbal medicine: implications for the health professions. Med J Aust,1997:166:538-541.
60. WHO. Guidelines for assessing quality of herbal medicines with reference to contaminants and residues. World Health Organization, 2007.
61. Sachan AK, Sachan NK, Kumar S, Sachan A, Gangwar SS: European journal of scientific research,2010:46(2):194-203.
62. Physical and Physicochemical Methods, European Pharmacopoeia, 6th edition, Chapter 2.2
63. Nikhat S and Fazil M: International Journal of scientific research and management,2013:1(8):415-420.
64. Dr Rajesh Kumari, Dr Mita Kotecha, A review on the Standardization of herbal medicines, International Journal of Pharma Sciences and Research, 2016.

65. Kiran Kulkarni, Gorakhnath Jagtap, Shrikant Magdum, A Comprehensive Review On Herbal Drug Standardization, American Journal of PharmTech Research, 2019, 9(03).
66. Ibameaimon Pohtam, Dr Devraj K, Mahendra Prasad Yadav, Anuradha KN Recent Updates in Ayurvedic Herbs Standardization, International Journal of Health Sciences & Research, 2019.
67. Rohit Kumar Bijauliya, Shashi Alok, Dilip Kumar Chanchal and Mayank Kumar, A comprehensive review on standardization of herbal drugs, International journal of Pharmaceutical sciences and Research,2017:8(9):3663-3677.
68. Kunle, Oluyemisi Folashade, Egharevba, Henry Omoregie and Ahmadu, Peter Ochogu, Standardization of herbal medicines - A review International Journal of Biodiversity and Conservation,2012:4(3):101-112.
69. Rucha Rathod, Raman R. Chandak. Standardization an Imp Tool for Herbal Drug Development, Journal of drug delivery and therapeutics,2019:9(6-s):253-257.
70. Sarukh VS, NAGOBA SN, Hindole SS, Kaudewar KD, More DR. Formulation and evaluation of herbal gel containing allium cepa extract. Journal of Drug Delivery and Therapeutics. 2019 Aug 15;9(4-s):492-6