Acta Scientific Pharmaceutical Sciences (ISSN: 2581-5423)

Volume 6 Issue 12 December 2022

Review Article

Strategies to Enhance the Stability of Herbal Active

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DOI: 10.31080/ASPS.2022.06.0915

Received: October 17, 2022

Published: November 28, 2022

Abstract

The market for natural products has experienced rapid expansion in recent years. It leads to the creation of numerous proprietary herbal products, the majority of which are composed of multiple ingredients. The development of herbal drug therapies has led to the discovery that many of the drug's components may interact with one another, which has led to severe concerns regarding the stability of such formulations, a crucial topic in the study of phytochemistry and natural medicines. National pharmacovigilance centers (or analogous institutions) will need to have specialized technical knowledge in order to manage herbal medications, in particular, to analyze the reasons of adverse occurrences. This will include qualified professionals in pertinent technical fields and resources to analyze the products in question, for which there is frequently little data and limited access to trustworthy information sources. Additionally, an effort has been made to gather a profile of herbal substances that improve drug bioavailability together with their mechanism of action (where known) and research on this enhancement.

Keywords: Natural Product; Herbal Drug; Phytochemistry; and National Pharmacovigilance Centers

Introduction

Herbal actives are also known as phytochemical or medicinal plants. According to World Health Organization (WHO), herbal medicine includes herbs, herbal material, herbal preparation, and finished herbal products that contain active ingredients, parts of plants, or other substances that can be used for the treatment of diseases and disorders [36,40]. The usage of synthetic drugs is causing an increasing number of diseases and illnesses. Hence, people are switching to traditional natural medicine [39]. Eighty percent of the total world population depends on herbal medicine for the treatment of primary health care, this estimate is from WHO [7,35,36,40].

The herbal actives consist of whole parts of the plant or are prepared from fresh or dried ingredients like fruits, seeds, roots, flowers, leaves, leaves, bark, flowers, etc.

Phyto-ingredients include pure constituents obtained by various processes like extraction, distillation, purification and fermentation [35].

They are easily administered by the oral route, inhaled or directly applied to the skin. The herbal medicines are easily available, low in cost, possess good safety and less side effects [36].

Stability is described as the capacity of a drug substance or drug product to keep its identity, strength, quality, and purity through retest or expiry date periods while remaining within stated parameters. The use of standardized extract in herbal medicines has become common. However, drug molecules or active components are subject to microbial attack, oxidation, hydrolysis and other environmental degradation during the production and extraction process for herbal medicines, posing a challenge to product stability [24].

The presence and concentration of bioactive constituents must be closely monitored because they affect the effectiveness, efficacy, and shelf-life of natural medicines. The quality difference between a herbal medicinal product including a natural product or Herbal Drug Preparation (HDP) with ingredients of established therapeutic efficacy during the proposed shelf-life shall not exceed ±5% of the initial tested value [34].

WHO guidelines for herbal drug stability

The WHO has established recommendations for the standardization of herbal drugs. It will help us to ensure that the plants have the required amount of medicinal and nutritive value, which is essential for the therapeutic activity required for the treatment or prevention of disease condition. It also helps to determine and understand about the efficacy, safety and toxicity profile of the drug.

The guidelines given by the WHO are classified as

Botanical parameters

Sensory evaluation

It includes the evaluation of the herbal drugs based on visual macroscopic, color, odor, taste, etc. for identification of the drug [23,31].

Foreign matter

It is done to determine whether the herbal drug contains any other substance like any organism or part of organism, or any other drug which is not related to the herbal drug; or any other inorganic material like sand, soil etc. There are several other methods given for the determination of the foreign matter, which are, manual method, lycopodium method, macroscopic and microscopic examination etc. [32].

Physicochemical parameters

Chromatographic fingerprint

Chromatographic fingerprinting is used to figure out the specific herbs' identities and qualities before they are put to herbal formulations. It includes the separation, identification, impurity detection and assay of herbal drug. It uses the following methods likes, high performance thin layer chromatography (HPTLC), high performance liquid chromatography (HPLC), gas liquid chromatography (GLC), thin layer chromatography (TLC) [34]. Based on the analyzed substances, fingerprint chromatograms display a specific chemical profile. Application of fingerprints should stay clear of problematic marker-based identification. Fingerprint analysis can also be used to control the stability of the chemicals and, consequently, the quality of the plants. It is proven that herbal items are pharmacologically or therapeutically equivalent when their fingerprints match those of clinically evaluated samples. Additionally, fingerprints can be employed in multivariate calibration, such as when modelling medicinal actions as functions of the fingerprint, such as antioxidant or cytotoxic effects [41]. The methods given by Dejaegher., *et al*. two columns and two rows of two full factorial organic modifying agents with linear gradient elution. Due to Two options are suggested for further optimization depending on the objective. A reduction in analysis time is modifying the gradient, runtime, or efficiency was suggested the testing of alternative buffers and their concentrations as well as a reduction in flow rate and temperature utilising a two-factorial design. If the plan fails to produce an sufficient fingerprint, additional columns, or organic modifiers is a possibility [42].

Ash value

It is used to determine the quality and purity of the drug. The residue remaining after the incineration of the crude drug is the ash content, which helps to calculate the ash value. There are different types of ash which are determined; it includes the following, likes Total ash (physiological and non-physiological ash), water soluble ash and acid insoluble ash.

Total ash

Empty silica crucible was weighed (W1). About 3 g (W2) of the air-dried Poly herbal powder (PHP) was added to the previously weighed crucible. The sample was heated to between 500 and 600 degrees in an electrical muffle furnace, where it was gradually lit until it turned white, signifying the lack of carbon. It was then chilled in a desiccator and weighed again (W3). The formula used to determine total ash content was total ash = ((W3- W1)/(W2-W1))×100.

Acid-insoluble ash

A total of 25 millilitres of diluted HCl were added to the crucible containing the total amount of ash. After that, it was covered with

watch glass and slowly boiled for 5 minutes. The watch glass was rinsed in 5 ml of hot water, and the washings were then placed to the crucible. After filtering the insoluble material with ashless filter paper and washing it in hot water till the neutral filtrate was achieved. The insoluble material was transferred from the filter paper to the original crucible, dried on a hotplate, and burned to a consistent weight (W4). After cooling in a desiccator for 30 minutes, the residue was reweighed. Weights W1 and W2 refer to the weight of the sample with the crucible for ignition. W3 is the final weight of sample including crucible weight after ignition and W4 is the constant weight after addition of HCl. Acid-insoluble ash content was calculated as, % acid-insoluble ash = (W4-W1)/(W2-W1)×100.

Water-soluble ash

25 ml of water was added to the crucible that contained the complete amount of ash, heated for 5 minutes, and then filtered through ashless filter paper. Hot water was used to wash away the insoluble material that had accumulated on the filter paper, and the filter paper was then ignited in a crucible for 15 minutes at a temperature no higher than 500°. After 30 minutes of desiccator cooling, the residue was reweighed (W5). The formula used to determine the percentage of water soluble ash was (W7-W6)100, where W1 represents the weight of the empty silica crucible, W2 represents the weight of the sample before ignition, and W3 represents the weight of the sample after ignition. W6 represents the weight of residue, which is equal to W5-W1, and W7 represents the weight of ash, which is equal to W3-W1. and water-soluble ash is W7-W6 mg/g [43].

Pharmacological parameters

Bitterness value

Most of the medicinal herbs comprise of strong bitter taste which have therapeutic value and are used as appetizing agents. The bitterness value is determined by comparing the thresh-hold bitter concentration of an extract material with that of quinine hydrochloride. The bitterness value is expressed as 1gm of quinine hydrochloride in 2000 ml.

Procedure: 0.1 gm of quinine hydrochloride is dissolved in 100ml purified water and the stock solution is prepared and diluted, it is then compared with drug.

Bitterness value in unit per gram = 2000×C÷A×B where,

A = concentration of stock solution

B = volume of test solution in tube with thresh-hold bitter concentration

C = quantity of quinine hydrochloride in the tube with thresh-hold bitter concentration.

Hemolysis property

Some drug containing saponins have the ability to cause hemolysis when mixed with 0.1 ml of blood, as the hemoglobin diffuses into the surrounding medium. It is calculated by comparing it to that of saponin R, a reference substance with a hemolytic activity of 1000 units per gram [39].

Astringent property

It is determined by amount of tannins present in the drug. Tannins are chemically complex compounds that are frequently found as polyphenol combinations. Astringents have the property of causing shrinkage in the body tissues.

Swelling index

Some of the herbal drugs may contain mucilage and so they swell up when they encounter water. The volume in ml taken up by the swelling of 1 gram of plant material under specific conditions is known as the swelling index. It determines the mucilage content of the drug; hence it is useful in the evaluation of crude drugs containing mucilage.

Foaming index

When an aqueous decoction is shaken, saponins in many therapeutic plants can induce foaming. Foaming index is a measurement of the ability of an aqueous decoction of plant materials and extracts to foam.

Foaming index is calculated using the formula 1000/a

Where, a = the volume in ml of the decoction used for preparing the dilution in the tube, where foaming to a height of 1 cm is observed.

Toxicological parameters

Arsenic and heavy metals

Some herbal drugs might contain arsenic and heavy metals which can cause toxicity to the human body. There are different methods to estimate the amount and concentration of heavy metals in herbal drugs.

Bhagyashree Behera., *et al*. determined heavy metal by using an atomic absorption spectrophotometer with a graphite tube atomizer (GTA).

Instrumental technique [49]

Working standard solutions ranging from 1 ppb to 15 ppb were created by diluting the standard stock solutions (1000 ppm) and then storing them at 4°C. Plots of the calibration curves were made between the concentration and measured absorbance. With a graphite tube atomizer-equipped atomic absorption spectrophotometer, the produced samples were examined right away (GTA 120). The instrument was run in GTA mode, the argon gas flow was set to 3 L/min, and the manufacturer's specified temperature ranges were followed. Table 2 provides a list of numerous heavy metals' optimal operating parameters. Every analysis was carried out in batches, which included comprised plant samples, reagent blanks, and standards (for calibration curves). In relation to the dry weight, the heavy metal concentrations were given in parts per million (ppm).

Radioactive contamination

Long-and short-lived fission products, actinides, and activation products are among the radionuclides that could be released into the environment and cause a nuclear accident. Microbial growth in herbals is usually avoided by irradiation. The nature and intensity of radionuclides are determined by the source (reactor, reprocessing plant, fuel fabrication plant, etc.). The radioactivity of the plant samples should be compared with the guidelines of the International Atomic Energy Agency (IAEA), in Vienna, Australia.

Stability study of herbal drugs

Herbal drugs are known for their medicinal, aromatic, or savory qualities. They are used on a large scale in today's world due to their safety and potency for the treatment or prevention of the disease condition. So, the stability conditions should be monitored strictly [1,19,27,31].

The goal of stability is to ensure that the drug and drug products remains within the specific condition for their identification, strength, quality, and purity.

The most important parameter in the evaluation of the stability study of a product is the storage condition of the herbal drug.

The factors which affecting the stability of herbal drugs include drug interaction, moisture content, microorganisms, environmental factor, storage condition, packaging, containers.

An herbal product's physical and chemical stability should be tested under specific storage circumstances, and its shelf life should be calculated.

Safety assessment

The safety evaluation of a pharmaceutical product has been used in the past without harming people. Unless new information requires a revised risk benefit evaluation, no special restrictive regulatory action should be taken.

Toxicological studies

If there are any toxicological studies available, they should be included in the evaluation. Toxicity data must be provided if a toxicological risk is known. Risk assessment should be documented, whether it is independent of dose (for example, unique risk allergies) or a function of dose.

According to WHO and International Council for Harmonization (ICH) guidelines:

Stability of herbal drug

- Q1A (R2): Stability Testing of New Drug Substances and Products.
- Q1B: Stability Testing of New Drug Substances and Products. Q1C: Stability Testing for New Dosage Forms.
- Q1D: Bracketing and Matrixing Designs for Stability Testing of New Drug Substances and Products.
- Q1E: Evaluation of Stability Data
- Q1F: Stability Data Package for Registration Applications in Climatic Zones III and IV.

On storage condition

The most important parameter in the evaluation of the stability study of a product is the storage condition of the herbal drug.

General case

Study	Storage condition	Minimum time period covered by data at submission
Long term	25°C ± 2°C/60% RH ± 5% RH or 30°C ± 2°C/65% RH ± 5% RH	12 months
Intermediate	30°C ± 2°C/65% RH ± 5% RH	6 months
Accelerated	40°C ± 2°C/75% RH ± 5% RH	6 months

Table 1: General case.

Drug substances intended for storage in a refrigerator

Study	Storage condition	Minimum time period covered by data at submission
Long term	5°C ± 3°C	12 months
Accelerated	25°C ± 2°C/60% RH ± 5% RH	6 months

Table 2: Drug substances intended for storage in a refrigerator.

Drug substances intended for storage in a freezer

Study	Storage condition	Minimum time period covered by data at submission
Long term	- 20°C ± 5°C	12 months

Table 3: Drug substances intended for storage in a freezer.

Issues related to herbal drug stability

Physical instability

Due to the presence of contamination or any interaction with the containers, herbal drugs frequently suffer from physical instability [5]. Growth of microorganism and insect feeding has an impact on chemical composition and secondary metabolites of plant. Volatile chemical ingredients in herbal drugs suffer from volatility and decreased activity when stored for an extended period of time. For example.

Herbal product	Stability condition	Findings	Reference
Azadirachta indica cream	25–30°C, 12 months	Stable	(Aremu, 2009)
Hippophae rhamnoides emulsion	8, 25, 40 and 40°C/75% relative humidity (RH), 4 weeks	Stable at temperature ≤25°C	(Khan., *et al*. 2010)

Table 4: Physical instability [32,33].

Chemical and physicochemical instability

During the storage condition the chemical or physicochemical drug suffer from oxidation, hydrolysis, crystallization, disintegration, and chemical degradation with the additives and ingredients. In an herbal drug, quality and stability are influenced by two primary factors like temperature and moisture. For every 10°C increase in temperature, a chemical reaction multiplies by two to three times. Absorption of moisture on to the solid herbal drug may lead to an increase in the rate of disintegration if it is vulnerable to hydrolysis. The amount of enzyme present in the drug causes the chemical degradation [24,34]. For example.

Herbal product	Stability condition	Findings	Reference
Allium sativum	Fresh blend, -80°C, tablets, 4°C and room temperature (RT), 2-3 years	Stable	(Lawson and Gardner, 2005)
Canlendula officinalis cream	8, 25, 40°C and accelerated stability (AS)	Stable	(Bernatoniene., *et al*. 2011)

Table 5: Chemical and physicochemical instability.

Environmental conditions

The environmental conditions such as temperature, soil, rainfall height as well as various harvesting, collection and manufacturing methods such as selecting, drying, extracting, can affected product quality and stability in the drugs. The production of free radicals by light source is another important factor that affected the phytochemicals. For example.

Herbal product	Stability condition	Findings	Reference
Peppermint oil	5°C, Long term stability (LT) and accelerated stability (AS)	Stable	(Kamurthy., *et al*. 2016)
Zingiber officinalis	Accelerated stability (AS) and Long term stability (LT)	Unstable at temperature ≥25°C	(Kumar., *et al*. 2020)

Table 6: Environmental conditions.

Complex mixtures, variability and inconsistency

Complex mixtures of various components are obtained by the extraction process in herbal preparation. Shelf life, activity, concentration, and consistency are all different for each component. It's impossible to predict the stability of a finished herbal product based on a single component's activity and stability profile. This causes a challenge during storage condition determination. For example.

Herbal product	Stability condition	Findings	Reference
Ginkgo biloba extracts and formulations	25, 40, 60 and 80°C, direct sunlight and direct sunlight + humidity, 6months	Stability decreases at high temperature, humidity and sunlight	(Marais., *et al*. 2001)
Curcuma longa extracts	Long term stability (LT) and 4°C Curcuminoids	Degrade significantly	(Green., *et al*. 2008)

Table 7: Complex mixtures, variability and inconsistency.

Drug interaction, degradation, decomposition and storage condition

Herbal drug or herbal preparation contains various phytochemicals of different chemical classes. These constituents may cause interaction on exposure to environmental conditions such as air, light, humidity, and storage of the materials. There are several active chemical ingredients in herbal preparations, including as alkaloids, glycosides, tannins, and flavonoids, and each component has a distinctive stability condition. As a result, the herbal formulation's actual stability condition differs from that of its separate components. For example.

Herbal product	Stability condition	Findings	Reference
Piper sarmentosum	Long term stability (LT), accelerated stability (AS) and 60°C/85% relative humidity (RH), 6 months	High temperature and humidity increases degradation	(Hussain., *et al*. 2012)
Beverages of *Carica papaya* and *Aloe barbadensis*	4°C, 3 months	Stable at temperature	(Sawant., *et al*. 2018)

Table 8: Drug interaction, degradation, decomposition and storage condition.

Where, AS= Accelerated Stability; LT= Long Term Stability; RT= Room Temperature; RH= Relative Humidity; IS= Intermediate Stability.

Different tools and techniques to deal with herbal drug stability

Different tools for dealing with herbal drug stability

Determination of the physical parameters

In the physical parameters the raw material availability, quality, and stability are the usual problems. During the different types of herbal preparations, sensory evaluation like color, odor, taste, etc. and other parameters like ash value, moisture content, and solvent residue need to be checked for its quality, purity and stability. Toxicological parameters like arsenic and heavy metals or other parameter like radioactive and foreign materials need to be identified for herbal drug preparation [3].

Determination of the impurity profile

This approach helps in the detection and identification of impurity in drugs and chemicals. Also helps in the identification of degradation (oxidation and hydrolysis) products. High performance liquid chromatography (HPLC), spectrophotometry, thin layer chromatography (TLC), and gas chromatography-mass spectrometry (GC-MS), etc. are the analytical method which can be used to identify impurity [17].

Thin layer chromatography

TLC is a distinct and incredibly trustworthy analytical tool for determining the identity and purity of any substance. Thin layer chromatography would require less time for development, would make it simple to see the separated compound, would speed up the separation process, would be less expensive, would only need a small sample size, and would use less solvent. TLC tests a larger polarity range, allowing for the detection of any contaminants. The identification of unknown impurities can be accomplished using the newly hyphenated Liquid Chromatography-Mass Spectrometry (LC-MS) technique, avoiding time-consuming isolation by simply scraping off followed by mass spectrometry (MS) determination for clarifying the structure of unknown impurities [44,45].

Limitations: Because TLC is an open structure, results are not entirely repeatable and trustworthy. Important variables like environmental changes and analyst variation may have an impact on the outcome. Only qualitative information is provided; quantification is not possible. Since it is a non-automated method, human error may also affect how accurate and correctly the output is produced. Recent technological improvements have made it possible to perform quantitative assessments using high accuracy densitometers and automatic multiple developments (AMD), which enhance the selectivity of the procedure.

Advantages of HPTLC over TLC [46]

The high-performance thin layer chromatography technique, which is advanced and automated, can be used to get beyond TLC's limitations. It gives consistent results and improves the analytical setting. In comparison to TLC, HPTLC provides higher resolution,

sensitivity, and speed. Automatic quantification is possible by using the densitometer to scan the plate. Two analysts working simultaneously can finish the analysis at once. reduced amount of solvent used in the analysis.

Gas chromatography

A special investigative tool for impurity profiling is gas chromatography. The main advantage of GC is its ability to isolate volatiles from non-volatile medium when compared to the specially used sample pre-treatment. Since no other method can be used to determine a residual solvent, GC is the only way to do so. High separation power, superior selectivity, and a variety of flame ionisation detectors are all features of GC (FID). For sample separation and detection, GC offers the highest potential; linearity can be attained up to 107 units. The sample pre-treatment method with the highest sensitivity is dynamic headspace.

Limitations

It cannot be used as a learning tool for studying a thermally unstable, non-volatile molecule. Since UV spectra cannot be taken, GC is a special separation method. The sensitivity is reduced when a direct injection form of sample pre-treatment is used.

High-performance liquid chromatography

An automated separation method with high levels of sensitivity, selectivity, and resolution power is the HPLC. The method is quick and effective for separating contaminants from the drug material and assessing purity. The reverse phase HPLC technology is widely utilised for the determination of contaminants in biological material. UV-detector can generate high-quality UV spectra when HPLC is used as a separation method. In this system, sample preparation is simple and error is also reduced [47].

Limitation

Following structural traits like UV chromophore, fluorescence element, or electrochemical activity, the compound must have these properties in order to detect the compound in HPLC and achieve the required detection power. Derivatization of the drug material allows for analysis of the drug substance that lacks structural components such a UV chromophore, a fluorescence component, or electrochemical activity [48].

Numerous developments in the modern age have significantly altered analysis methodology, sped up the procedure, and reduced the amount of work required. Online analysis not only saves us time, but it also provides qualitative and quantitative information about an unidentified contaminant. Impurity profiling has made considerable use of the hyphenated approach. Depending on the need, either one of the approaches can be used for the monitoring of the impurity, or a mix of ways can be used.

Identification and quantification of all metabolites

The stability of complicated mixtures is determined by identifying and quantifying all metabolites in herbal medication preparation. IR spectroscopy technique is used to determine the metabolic complex mixture present in the preparation [18].

Controlling storage condition

Controlled storage condition is important for the products. This is because during the storage condition there may be chances of any physical or chemical contamination which may lead to degradation or moisture uptake by the product. Hence, the product should be stored in airtight container or protected from light.

Different techniques to deal with herbal drug stability

Topical herbal formulation

An herbal formulation is a dosage form of medicament comprising of two or more active ingredients. The formulation can be a cream, lotion, shampoo, etc. In the preparation of nanoemulsion we have an aqueous phase and oil phase. The aqueous phase is the phase which comprises of the active ingredients. It is dispersed in the oil phase which is made by extraction of essential volatile oils from the herbs. It can be applied topically to an individual for treatment of disease conditions like acne, psoriasis, eczema etc. They have higher ability to penetrate the tissues under the skin. They are highly stable and so have a longer shelf life. Topical herbal formulations are used on a very large scale because of lower side effects and less toxicity profile [30].

Emulsion form of herbal products

A study about the storage stability and quantity and size of globules in herbal extract generated by dispersing ethoxypolysiloxane in water loaded with emulsifiers such as methyl cellulose, Tween 20 and oleinol-7 (heptaethylene) glycol mono-oleate, showed that during storage at room temperature the viscosity of Tween 20 emulsions increased after storage,

but the globule size and number remained as it is. The oleinol-7 (heptaethylene) glycol mono-oleate emulsion was the least stable. The emulsion's capacity to control foaming of aqueous solutions containing plant extract was maintained throughout the storage time [9].

Suspension form of the herbal products

In the case of suspensions, the preparation's stability is important. It is dependent on viscosity and some other various parameters. Viscosity of the formulation can be modified by adding the viscosity enhancing agents like xanthan gum and other cellulose derivative etc. While comparing xanthan gum and cellulose derivatives, it was observed that cellulose derivatives have lesser viscosity and so they may reduce the stability of the preparation. Suspending agents and the nonionic surfactants can be used to improve the stability of the insoluble or less soluble plant extracts [25].

Antioxidants and liquid formulations

To minimise oxidation, antioxidants including *Glycyrrhiza glabra*, *Ginkgo biloba*, flavanol ester, polyphenol and fatty acids should be used. Antioxidants serve as free radical scavengers, making liquid formulations more stable [37].

Tablet formulation for volatile liquids

A visually stable tablet loaded with volatile liquid active medicine is made by damp proof- coating after incorporating and hydrating the volatile liquid active drug. The process included making the volatile liquid active drug to be included in β-cyclodextrin, moisturizing with colloidal silicon dioxide, blending with other additives, pressing out into fixed size to prepare dry granules, blending with disintegration agents, lubricants, and re-pressing out to make a tablet, followed by damp proof-coating with polyvinylacetaldimethylaminoacetate acetate [15].

Nanoparticle coating for enhancing the shelf-life of a natural

The active component in herbal formulations is nanocoated to protect it against oxidative, hydrolytic, and environmental degradation processes, extending the shelf life of the medication. Developing nano dosage forms for herbal drugs, such as liposomes (protection from enzymatic degradation), polymeric nanoparticles (nanocapsules and nanospheres), nanoemulsion, proliposomes, solid lipid nanoparticles, and so on, has several advantages, including improved solubility and bioavailability, toxicity shielding, and pharmacological efficacy. Liquid dosage formulations of stable nanoparticulate medicines have a better level of stability than conventional formulations [14].

Powders with oil composition containing aqueous active substance

Herbal drugs can be powdered and used to get the desired therapeutic effect. It consists of base powder obtained from the herbal drug and has oil components. These oil components are made by drying the water in oil type of emulsion which includes an aqueous phase as well as an active ingredient. After extraction of the plant, the extract along with the flavourants are mixed with the powdered herbal drug, and by using flavours, the unpleasant taste of the used ingredient can be masked. The powder can be made from acacia, tragacanth etc. [35].

Herbal compositions with high content of herb medicine extracts

Calcium silicate is used to increase the stability of the pharmaceutical preparations having a larger amount of herbal plant extract. The extracts may consist of anthrones and porous calcium silicate and the relative humidity condition is maintained at 40%. They tablets prepared by using herbal ingredients may have liquorice extract, crystalline cellulose, magnesium stearate etc. [8].

Chelating agents for stabilization of the aqueous plant extracts

By adding a water soluble chelating agent to a plant extract obtained during the extraction procedure, the extract can be stabilized. Polyvinylpyrrolidone (PVP), can be used to stabilize water soluble aqueous plant extracts [12].

Novel approach for natural products

When compared to existing dosage forms of the same component, quick dispersion, fast dissolving, short disintegration time and fast absorption by the human body, stability and high bioavailability, good flavour, and simple ingestion are all advantages of chewable tablet composition. For example, Compared to liquid and injectable formulations, a chewable tablet combining *Ardenia jasminoides* and *Herba artemisiae* Scopariae fruit is created to have improved stability and bioavailability [11].

Formulations without the use of the stabilizer

Nowadays stable herbal preparation can be prepared without using the stabilizer. Stability can be affected by sealing the drug instead of the active ingredient. As a sealing component, water-soluble polymers such as cellulose ethers are utilized. Exposure to high-temperature, high- relative-humidity storage conditions has little effect on the preparations [36].

Linctus for herbal preparations

Extracts of medicinal plants *Zingiber oificinale* and *Ocimum viride* were formulated into an antitussive preparation in the linctus herbal preparation to reduce cough. Formulation is used to determine physical properties of the linctus formulation, such as specific gravity, viscosity, content uniformity, pH, and shelf-life. viscosity, Specific gravity and other formulation parameters are more stable and have greater values when made with glycerin [20].

Summary and Conclusion

In the present era, herbal medicines are in higher demand, because of rapid advancement in herbal drug industry. But here, the storage conditions like pressure and temperature should be strictly monitored so as to maintain the drugs stability; this will prevent the formulation from getting degraded even if it is stored for a longer duration of time. Also the safety profile of the drug should also be considered and should not be neglected. The herbal drug formulation should have the required pharmacological and therapeutic effect. If two or more active drug moieties are mixed together for manufacturing of a phytoformulation, then its stability should be monitored and should be considered as a very important parameter.

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