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(RESEARCH ARTICLE)

Development of herbal capsules containing standardized polyherbal extracts

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Abstract

With increasing popularity of herbal medicine, the production of safer, more effective, standardized formulations of herbal medicine for management and prevention of various health conditions has also increased in demand. The objective of this study was to create hard-gelatin herbal capsules with standardized polyherbal extract compositions, evaluate their physical and chemical properties (e.g., density), and assess their quality attributes. The selected plants had antioxidant, anti-inflammatory and immunomodulatory activity; they were identified, authenticated and extracted using appropriate hydroalcoholic extraction methods. For each medicinal plant extract an evaluation was performed against the appropriate phytochemical marker in order to standardize the extracts based on those markers, and the bioactive constituents were examined these included alkaloids, flavonoids, phenolics, tannins, saponins and glycosides. Following the standardizing of individual extracts, the extracts were combined in optimal ratios for the development of hard-gelatin capsules, for use with appropriate excipients to achieve consistency and stability along with improved patient compliance. The evaluations done on prepared capsules contained assessments for organoleptic properties such as taste; weight variations; moisture percentages; disintegration times; and uniformity of drug content according to standards set forth by pharmacopeias. In vitro dissolution tests have provided satisfactory release patterns for phytochemical substances (in terms of bioavailability). Stability testing performed under accelerated conditions indicated that there was no evidence of physical or chemical instability with regard to any quality parameter of this formulation. Phytochemical analysis also supports the presence of all active phytochemicals throughout the entire manufacture of this formulation. Flowabilities, overall quality characteristics, and it would appear that there are numerous potential therapeutic applications of these capsules with respect to synergism between various herbal ingredients. This work demonstrates the advantages of standardized polyherbal capsule formulations; including convenience, stability, and efficacy in the administration of bioactive herbal materials. In addition to offering an alternative to synthetic medications, standardized polyherbal capsule formulations are an important step toward the establishment of evidence-based herbal medicine. Therefore, further clinical and pharmacological research will be required to assess these formulations' efficacy and safety with regard to their use in humans.

Keywords: Polyherbal capsules; Standardized extracts; Herbal formulation; Phytochemicals; Quality evaluation; Stability studies; Nutraceuticals.

1. Introduction

Since thousands of years ago, people have used herbs for not only treating illnesses, but also for preventing illness. Herbal medicine played an important role in traditional systems of health care around the world. Awareness of the dangers connected with the use of synthetic drug products has led to an increased consumer interest in the use of natural format for their health care needs. In many developing countries today, approximately 80% of the population does rely on herbal medicine for their primary health care needs (WHO 2019). Herbal medications typically are perceived as being safe and not expensive and therefore will have less side effects when compared with conventional

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medicines; thus, herbs are becoming increasingly popular as a source of health care among both consumers and medical professionals alike.

Utilizing multiple plants containing therapeutic properties is known as polyherbal (or poly-pharmaceutical) therapy. The basis of polyherbal therapy refers to the concept that the combination of multiple herbs (polyherbal) will result in an enhanced effect, and will help reduce other possible negative effects associated with individual herb products. Wagner (2011) indicated that polyherbal products have better pharmacological properties than do the individual components alone due to the synergistic actions of the various phytochemicals present in a single polyherbal formulation. Polyherbal formulations are frequently used to treat conditions related to inflammation, metabolic disorders, immune system failure, and oxidative stress.

The current trend towards standardization of herbal products is an important step in maintaining good quality, safe and effective therapeutic agents. Variability of the plant species used as well as their geographical origin, harvest method and extraction process will all affect how much of the bioactive constituents are present in each herbal preparation (Kunle et al., 2012). Standardization is the process of identifying and quantifying the phytochemical markers contained in an herbal product and developing quality control measures to provide consistency from batch-to-batch. The application of modern analytical methods (i.e., high-performance liquid chromatography [HPLC], thin-layer chromatography [TLC] and spectrophotometry) has assisted greatly in producing standardized herbal products and increasing their overall acceptance in current healthcare systems.

Of the various dosage forms available, the advantages of using capsules as a form of pharmaceutical formulation include convenience and ease of swallowing for patients; accurate dosage administration; greater product stability; eliminating the unpleasant taste; masking odours; and increasing patient compliance (Aulton and Taylor, 2018). One of the most common uses of hard gelatin capsules is for the formulation of herbal products due to their ability to protect against environmental influences as well as to provide a vehicle for the addition of powdered extracts and other pharmaceutical excipients. In addition, encapsulation has been shown to protect against degradation of sensitive phytoconstituents and assist with the controlled release of active compounds.

Many of the benefits that can come from polyherbal formulations are derived from the phytochemicals typically found in plants that are used as medicine; these include alkaloids, flavonoids, tannins, phenolics, saponins, glycosides, and terpenoids. These compounds are known to have various activities, including but not limited to antioxidant activity and anti-inflammatory activity, antimicrobial activity, hepatoprotective activity, antidiabetic activity, and immunomodulatory activity (Pandey & Rizvi, 2009). There are numerous studies that have demonstrated the synergy between various compounds in these formulations, which has resulted in increased bioavailability as well as enhanced therapeutic outcomes. As such, the development of standardized polyherbal capsules represents a valid means by which to utilize the benefits of medicinal plants through a stable and reproducible dosage form.

Polycultural practices have been found to be extremely common among those who utilize herbal products, but there are still major issues with quality control, contamination or adulteration , and inconsistency of phytochemical content in the product. Therefore, many regulatory agencies and researchers have focused their attention on the technical validation as well as standardization of herbal formulations to ensure safety and effectiveness (Mukherjee, 2019). The development of standardized polyherbal capsules would require proper selection of the correct medicinal plants (proper botanical identification based on good taxonomy), optimization of extraction methods, phytochemical analysis/identification of compounds in herbal products, and assessment of the physical/chemical properties of the herbs, in accordance with established pharmacopoeial standards. Through this process, researchers can produce reliable herbal products that can be marketed for commercial or therapeutic purposes.

The last decade has seen significant improvements in both phytopharmacological research and the advancement of pharmaceutical technology, thus permitting the creation of new types of herbal medicines that are more stable and bioavailable than before. The growth of standardised herbal products through the use of polyherbal capsules has created great interest because of their ability to contain multiple active compounds in one unit thus allowing for and ease of use as nutraceuticals/congototherapy. These products offer a unique solution for managing many chronic diseases by promoting health and well-being through the use of herbal forms.

This study will therefore investigate the development and characterisation of standardised multi-herbal products in capsule form. Quality standards will be established, and the capability of the newly developed capsule products as an effective and stable form of herbal therapy will be assessed. The results will contribute to the scientific support of this area of herbal therapy and may help meet the demands for herbal therapies to have an evidence-based approach.

1.1. Selection of Medicinal Plants

Polyherbal capsules are developed through the selection and preparation of numerous types of plants with documented healing abilities that have been used over time. The decision to include a certain plant in the formulation process depends on what type of chemical compounds the plant has even used historically, and how well that particular plant works with many others. The herbs that are most commonly used for polyherbal capsules include *Withania somnifera* (*Ashwagandha*), Curcuma longa (*Turmeric*), Tinospora cordifolia (Guduchi), and Ocimum sanctum (Tulsi), all of which display antioxidant, anti-inflammatory, immune-modulating, and adaptogenic qualities. These herbs work together in polyherbal formulas to produce an "enhanced level of therapeutic effect" through a synergistic interaction of the bioactive compounds of each individual herb (Mukherjee, 2019).

1.2. Authentication and Processing of Plant Materials

To ensure the botanic identity of herbal ingredients as well as the inherent purity and quality, proper authentication of plant materials is of utmost importance. Fresh or dried plant material is obtained from an authoritative source, authenticated by an expert taxonomist or pharmacognosist, and determined to be free from any extraneous, dust, and/or contaminants before they are dried under controlled conditions to prevent the degradation or alteration of their associated phytochemical properties. After the plants have been dried, they are ground to a fine powder in order to allow for efficient extraction of their bioactive ingredients. The implementation of the World Health Organization's Good Agricultural and Collection Practices (GACP) also plays a key role in ensuring the ongoing quality and consistency of medicinal plants (WHO, 2019).

1.3. Extraction and Preparation of Polyherbal Extracts

The extraction of bioactive constituents of medicinal plants is one of the most important steps involved in obtaining herbal medicines. The most commonly used solvents include hydroalcoholic solvents such as ethanol, methanol, water, etc., which vary based on the polarity of the desired phytochemicals. Different extraction techniques (e.g., maceration, Soxhlet extraction, percolation, or ultrasonic-assisted extraction) are used to extract the maximum amount of active compounds, and concentrated extracts are filtered and dehydrated to produce semi-solid or powdered extracts. The final extracts are then mixed in predetermined proportions to produce polyherbal mixtures that provide added synergy and improved biological activities when used together (Pandey and Rizvi, 2009).

1.4. Standardization of Herbal Extracts

To maintain batch-to-batch quality, safety and efficacy of herbal products, standardization is critical. The extracts used in these products undergo phytochemicals screens to determine the presence of certain chemical compounds including: alkaloids, flavonoids, phenolics, tannins, saponins, glycosides and terpenoids. Quantitative estimates of the chemical marker compounds can be measured through chromatographic or spectroscopic methods (e.g., HPLC, TLC, UV-VIS) which assist in confirming quality of the herbal extracts. By reducing the variability caused by environmental conditions, plant harvesting time and the manner of processing plants, standardization of herbal extracts supports enhanced therapeutic reliability (Kunle et al., 2012).

1.5. Formulation of Herbal Capsules

The core polyherbal extract is equilibrated (standardization), before combining it with pharmaceutical excipients to create a finely blended powder mixture for encapsulating into hard gelatine or vegetarian capsules. This process is done using a capsule filling machine. Some benefits of taking medications in capsule form are that they provide accurate dosing, mask the taste and smell of the medication, and can be more convenient to use for patients. Encapsulation has many other benefits as well, including protecting the phytoconstituents of the herbs from environmental degradation and increasing the shelf life of the final product (Aulton and Taylor, 2018).

1.6. Evaluation of Physicochemical Properties

Capsules that have been produced will then be assessed to ensure that they adhere to definitions set by Pharmacopeia. Some of these include; Weight Variation – an indicator of formulation; Moisture Content; Disintegration Time; Friability; and Content Uniformity (as they pertain to either uniformity of weight or disintegration and dissolution profiles). All these will tell if a batch of capsules is of high-quality and tested based on their performance after having been produced (Indian Pharmacopoeia, 2022).

1.7. Phytochemical and Pharmacological Significance

Polyherbal capsules contain multiple phytochemicals contributing to their wellness effects, including flavanoids and phenolic components that provide strong antioxidant effects through scavenging free radicals and decreasing oxidative stress. Alkaloids and glycosides are responsible for antimicrobial and anti-inflammatory properties, and terpenoids and saponins have immunomodulatory and hepatoprotective properties. The synergism between all of the following compounds improves their bioavailability, improves pharmacologic efficacy, and makes polyherbal preparations useful for treating chronic conditions and improving overall health (Wagner, 2011).

1.8. Stability Studies and Quality Assurance

Stability testing is done in various temperature and humidity circumstances to check the physical, chemical, and microbiological stability of herbal capsules. The following will be monitored through duration for such parameters as: Appearance, water content, drug content and dissolving profile. Accelerated stability tests provide information about shelf life and storage conditions Quality assurance processes, such as compliance with Good Manufacturing Practices (GMP), help ensure that all herbal formulations produced are safe, effective and consistent for commercial use. (Mukherjee, 2019).

1.9. Therapeutic Applications and Future Prospects

Due to their wide range of therapeutic uses, standardised polyherbal capsules are becoming more popular as nutraceuticals and supplementary medications. The immune system, stress levels, inflammation, metabolic problems, and antioxidant protection can all be improved with the help of polyherbal capsules. There is a chance to further develop herbal products with scientific proof to support their usefulness, thanks to the increasing consumer demand for natural goods and improvements in phytopharmaceutics. Additional data addressing the safety and efficacy of polyherbal capsule formulations will be provided in the future through scientifically-based pharmacological research, toxicity evaluations, and clinical trials.

2. Pharmacognostic analysis of botanical constituents

2.1. Gathering and verifying botanical specimens

It was in the Thane district that the bark of Terminalia arjuna, Chrysanthemum indicum flowers, and Moringa oleifera leaves were assembled. Following this, the plant materials were verified by Ideal College of Pharmacy and Research in Kalyan.

Figure 1 *Terminalia Arjuna, Chrysanthemum indicum* and *Moringa oleifera*

2.2. Preparation of extracts

Carefully rinsing the 500 g of collected Terminalia arjuna bark, Chrysanthemum indicum flowers, and Moringa oleifera leaves with purified water removed any impurities. The collected materials were allowed to dry for three to four weeks in the shadow of the laboratory at room temperature (24 ± 2 °C). Upon completion of drying, the plant material was reduced to a coarse powder by screening and then passed through a mechanical grinder. Separate reflux procedures were employed to separate the plant powder from the distilled water and ethanol (99.9%). To make each extract, the material was air-dried and then concentrated by vacuum distillation. The obtained crude aqueous and ethanol extracts were stored at 4 °C before analysis. The formula for calculating the extract's percentage yield is given below. How much of the plant material remains after extraction is divided by the weight of the dried crude extract to get the yield as a percentage. The weight in grams was used to compute the X hundred percent yield. The calculated yield % is presented here:

Table 1 Percent Yield of Different Extracts

No.	Extract	Percentage yield
1	Aqueous extract of Bark of *Terminalia arjuna*	7.24%
2	Aqueous extract flowers of *Chrysanthemum indicum*	6.34%
3	Aqueous extract leaves of *Moringa oleifera*	4.48%
4	Ethanol extract of Bark of *Terminalia arjuna*	8.54%
5	Ethanol extract flowers of *Chrysanthemum indicum*	5.35%
6	Ethanol extract leaves of *Moringa oleifera*	7.78%

2.3. Phytochemical screening

The usual approach for phytochemical screening is shown in Table:

Table 2 Preliminary Phytochemical Screening

Chemical constituents	Chemical test
Proteins	Biuret test
Carbohydrates	Molish test
	Fehling's test
Alkaloids	Dragendorff's test
	Mayer's test
Steroids	Salkowaski test
	Liebermann-burchard test
Triterpene	Vanillin-sulphuric acid test
Tannins	Ferric chloride test
	Dilute nitric acid test
Glycosides	Keller-killani test
Flavonoids	Shinoda test
	Lead acetate test
Saponins	Foam formation test
Amino acids	Ninhydrin test

2.4. Preformulation studies

Determining the basic physical and chemical characteristics of the medication powder is critical before formulating any dosage forms.

2.5. Definition

In order to construct the best possible drug delivery system, preformulation entails applying biopharmaceutical concepts to the physicochemical properties of the medicinal material. The following considerations should be made by the preformulation scientist prior to commencing the preformulation programs:

- How much medication is on hand.
- The drug's recognised physicochemical qualities.
- The expected dosage and therapeutic category of the substance.

- What kind of data a formula needed or would benefit from having

2.5.1. Selection of excipients

Excipients such as diluents (filler), binder, disintegrating agent, lubricant, and preservatives are necessary for the manufacture of capsules together with the active ingredients. The present Food and Drug Administration (FDA) requirements were considered while selecting the excipients.

2.5.2. Diluents

When the amount of active ingredient is too little or too difficult to fill, diluents or fillers are added. Ingredients including microcrystalline cellulose, lactose, and dicalcium phosphate are commonly used as fillers in tablets and capsules.

2.5.3. Lubricants

They make the filling process easier by reducing friction. Plus, they help keep the capsule substance from sticking. Numerous lubricants find widespread application, including stearic acid, talc, hydrogenated vegetable oils, and magnesium stearate.

2.5.4. Glidants

By lowering the particle-to-particle friction, it enhances the flow of powder materials. Starch, colloidal silicon dioxide, and talc are the best glidants.

2.5.5. Preparation of formulation

A tray drier was used to dry the CTEE (Combination of Three Ethanolic Extracts) at 60 °C for 20 minutes. The preservatives were the only excipients not dried in a tray drier at 100oC for 30 minutes; all others were dried individually. After thoroughly mixing all of the active ingredients according to the recipe, the mixture was lubricated with magnesium stearate. Then, the diluents and preservatives were added. After 30 minutes of blending, the ingredients were fully combined. After that, the powder was placed into the plastic bags and marked for subsequent analysis.

2.6. Development of formulation-trial batches

Three prototype batches were created by adjusting the amounts of the excipients to achieve optimal flow characteristics.

Table 3 Creation of a recipe

No.	Materials	Trial-1 (g)	Trial-2 (g)	Trial-3 (g)
1	CTEE	20	20	20
2	Talc	1.7	1.8	2.5
3	Mcc	0.8	0.9	1
4	Starch	2	2.5	2.6
5	Magnesium stearate	0.8	1	1.5
6	Colloidal sillicon dioxide	0.25	0.28	0.3
7	Bronopol	0.15	0.15	0.15
8	Sodium methyl paraben	0.15	0.15	0.15

2.6.1. Evaluation of blended powder

Various flow properties, including bulk density, tap density, compressibility index, Hausner's ratio, and angle of repose, were examined in the blended powder from each of the test batches.

2.6.2. Bulk density and tap density and Carr's index

A 50 ml measuring cylinder was used to collect a measured amount of powdered material, which was 15 grams. I tapped the contents and recorded the initial volume (vo). Then, after 50 taps, I recorded the powdered volumes (v50). Fluff density = weight/volume grams/cubic centimetre; taped density = weight/volume fifty grams/cubic centimetre; and so on. Here is the formula for Carr's index:

2.6.3. Carr's index = {Tapped density- Fluff density/ Tapped density} X 100

If the Carr's index is less than 15, the material flows well, and if it is between 20 and 30, the material flows poorly.

2.6.4. Angle of repose

On a burette stand, a funnel was set at specific heights (1.5, 2.5, 3.5 cm). Beneath the funnel on the table lay a sheet of white paper. The medication powder was gradually deposited into a mound as it made its way down the funnel. A note was made of the pile's radius. The formula was used to determine the powder material's angle of repose :

Tan θ = h/r,θ = tan (h/r) where, h = height of the pile, r = radius.

Angles of repose less than 30 degrees often signify a material that flows freely, whereas angles more than 400 degrees indicate a material that flows poorly.

2.6.5. Hauser's ratio

The fundamental step is to tap the material until no more changes in volume occur, and then measure the unsettled apparent volume (V0) and the final tap volume (Vf) of the powder. Here is the formula for calculating Hausner's ratio:

2.6.6. Hausner's ratio = V0/Vf

The flow is considered excellent when the Hausner ratio is between 1.00 and 1.11, and very bad when it is greater than 1.60.

2.6.7. Formulation of capsules

The data mentioned above were used to choose one optimised batch from the three experimental batches for formulation. After careful examination, trial batch 3 was chosen for further evaluation since it was determined to be the ideal batch.

Table 4 Final batch composition -250 mg/capsule

No	Ingredients	Quantity in mg
1.	CTEE	200
2.	Micro crystalline cellulose	12.5
3.	Starch	7.4 -10
4.	Sodium methyl paraben	0.25
5.	Talc	25
6.	Colloidal sillicon dioxide	3.7
7.	Magnesium stearate	0.85
8.	X-Bronopol	0.25

A compact shell, often composed of gelatin, encases one or more therapeutic and inert components in a dosage form known as a capsule.

2.7. Capsule Size and Selection of Filling Method

- To achieve an average net content t weight of 270 mg, the granules that were prepared were packed into "1" size capsules.

- After dedusting, the capsules were placed in polybags and tagged. The samples were then tested according to the specified protocols.
- The capsules used in this investigation were filled with gelatin using a machine that was controlled by hand.
- In accordance with the testing criteria, samples were collected from the last experiment to conduct expedited stability tests.

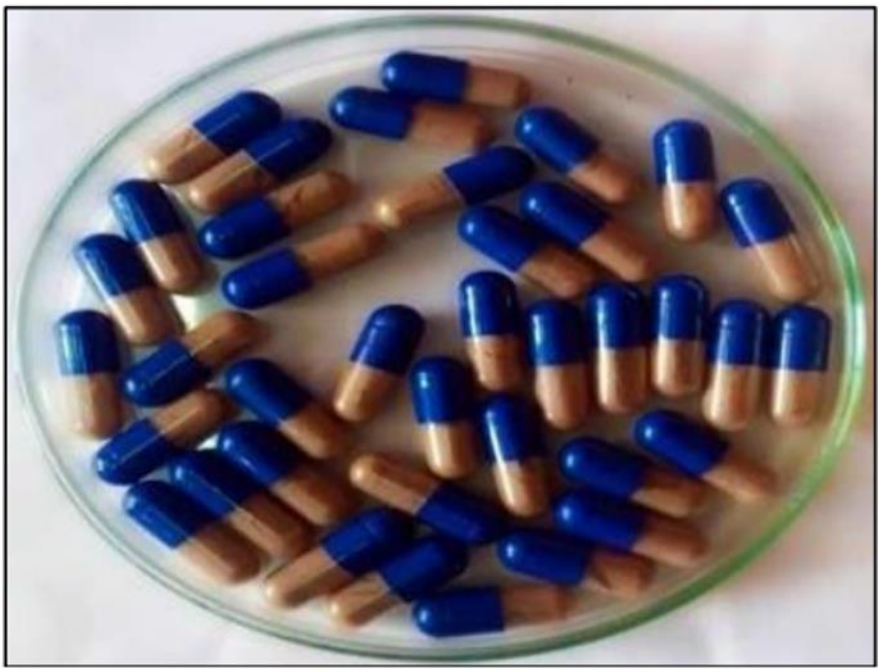

Figure 2 Herbal capsule

2.8. Standardisation of herbal capsules

Specifications, weight uniformity, disintegration time, moisture content, physicochemical characteristics, phytochemical investigations, and fluorescence analysis were all standardised for the herbal capsules that were produced. The standards were set in accordance with the protocols established by the Indian Pharmacopoeia. The evaluation included the following quality control parameters:

2.8.1. Description

The visual identity, general "elegance," and overall look of a capsule are crucial for customer approval. The created capsules are documented according to their colour, shape, smell, and surface texture.

2.8.2. Uniformity of weight

We weighed the contents of twenty randomly chosen units and determined their average weight. The percentage given in the table is the maximum deviation from the average weight for any two individual weights.

Table 5 Acceptance Criteria I.P Limit

Dosage form	Average limit	Deviation
capsules	< 300 mg	10%
	>300mg	7.5%

2.8.3. Disintegration test

Our digital microprocessor-based disintegration test device was used to conduct the disintegration test. Each tube was supplemented with a disc after one capsule was inserted into it. In a 1000 ml beaker, the components were suspended in water. The water volume was such that the wire mesh, when measured vertically, was at least 25 mm below the

water's surface and at least 25 mm above the beaker's base. The temperature was maintained at 37±2 °C by operating the equipment (Indian Pharmacopoeia, 2010).

3. Results and discussion

Table shows that CTEE included many key phytochemical categories identified in preliminary phytochemical screening, including alkaloids, carbohydrates, tannins, steroids and sterols, triterpenoids, saponins, and flavonoids.

Table 6 Screening for phytochemicals of three plants

Chemical constituent	**Chemical test**	**Bark of *Terminalia arjuna***	**Flowers of *Chrysanthemum indicum***	**Leaves of *Moringa oleifera***
		Ethanolic extract	Ethanolic extract	Ethanolic extract
Proteins	Biuret test	+	+	+
Carbohydrate	Molish test	+	+	+
	Fehling's test	+	+	+
Alkaloid	Dragendorff's test	-	-	+
	Mayer's test	-	-	+
Steroids	Salkowaski test	+	-	-
	Liebermann-burchard test	+	-	+
Triterpene	Vanillin-sulphuric acid test	+	-	+
Tannin	Ferric chloride test	-	+	+
	Dilute nitric acid test	-	+	+
Glycoside	Keller-killani test	+	+	-
Flavonoid	Shinoda test	-	+	+
	Lead acetate test	-	+	+
Saponins	Foam formation test	-	-	+
Amino acids	Ninhydrin test	+	-	-

Phytochemical research has identified a number of bioactive molecules found in plants, including tannins, alkaloids, carbs, terpenoids, steroids, flavonoids, and saponins, among others.

3.1. Result of polyherbal formulation capsule

Sample material was chosen from a mixture of three ethanolic extracts (CTEE): bark of Terminalia arjuna, flowers of Chrysanthemum indicum, and leaves of Moringa oleifera. The substance was subjected to a series of tests to ensure it met the quality requirements set out by the World Health Organization (WHO), pharmacopoeial conventions, and other authoritative sources.

3.2. Preformulation Studies

The herbal formulation was examined for preformulation characteristics such as bulk density, tap density, Hausner's ratio, Carr's index, and Angle of repose in three trial batches. You can see the results in the table.

Table 7 Completion of the batch - 250 milligrams each pill

No	Ingredients	Quantity in mg
1.	CTEE	200
2.	Micro crystalline cellulose	12.5
3.	Starch	7.4 -10
4.	Sodium methyl paraben	0.25
5.	Talc	25
6.	Colloidal sillicon dioxide	3.7
7.	Magnesium stearate	0.85

Table 8 Assessment of process variables

Parameters	**Trial-1**	**Trial-2**	**Trial-3**
Bulk density (g/cm)	0.42±0.01	0.38±0.05	0.35±0.04
Tap density (g/cm)	0.45±0.03	0.47±0.01	0.50±0.04
Compressibility index(%w/w)	26.83±0.66	23.26±2.54	13.06±1.12
Hausner ratio	1.35±0.15	1.22±0.02	1.13±0.01
Angle of repose	40.42±2.57	39.36±2.67	34.66±0.18

The standard mean deviation ± is used to express all values, with n=3.

Table 9 Assessment of process variables

Parameters	**Trial-1**	**Trial-2**	**Trial-3**
Flow property	Normal	Fair	Perfect
Filling	Uniform	Uniform	Uniform
Weight	Not uniform	Not Uniform	Uniform
Moisture content	Satisfied	Satisfied	Perfect
Disintegration time	Within the limit	Within the limit	Perfect

The aforementioned metrics validated that the blend's flow characteristic, which is required to be within a decent range according to the criteria, is suitable for filling the capsules. The third batch of the trial was chosen for the capsule filling because of its good flow characteristics. All parameters were within the specified ranges, and the flow qualities of experiment 3 were excellent. Therefore, more research will focus on the third study.

3.3. Standardisation of finished formulation

Table 10 Organoleptic characters

Name of test	**Observations**
Description	Pale brown powder contained in purple cap/ transparent body “1” size capsule
Coluor	Reddish brown powder
Odour	Characteristic odour
Taste	Bitter

Organoleptic, physical, and physicochemical characteristics were all evaluated in the last batch. Table 1 displays the results.

Table 11 Physical parameters

Name of the test	Observations
Moisture content	3.6 % ± 0.22
Uniformity of weight	268 mg ± 4.5mg
Disintegration time	3.32 (min) ± 0.34
pH (1% aqueous solution)	7.33 ± 0.21

Dosage forms are significant because of the drug's pace and degree of absorption into the circulation. When developing and, eventually, controlling the quality of a dosage form, it is vital to conduct in vitro dissolution and in vivo bioavailability studies. In order to create a stable and patient-acceptable medication preparation, formulation studies are conducted. Making a tablet or capsule out of the medicine is the standard method for administering it orally. With the right dosage and mix, plant-based medicines may be safely and effectively utilised to treat a wide range of diseases.

4. Conclusion

The study identifies the manufacturing of herbal capsule formulations based on standardized polyherbal extract formulations as a viable method of delivering natural bioactive compounds through a stable and convenient delivery system. The use of medicinal plants with known traditional uses combined with the use of established pharmacological properties through standardization procedures and extraction processes ensures that the final product will be consistent, of good quality, and safe to use. Through the use of phytochemical analysis and quality control methods, the standardization of extracts minimizes the potential for variability between batches of products as well as increases the reliability of therapeutic benefits. The formulated polyherbal capsules have displayed adequate physicochemical characteristics such as acceptable weight uniformity, acceptable disintegration time, and acceptable content consistency, suggesting that these capsules could be administered orally. A variety of phytoconstituents including flavonoids, phenolic acids, alkaloids, tannins, saponins, and glycosides found in polyherbal capsules have been demonstrated to have a variety of biological activities, including antioxidants, anti-inflammatory, antibacterial, antifungal, and immune system-modulating effects. The increased activity of phytoconstituents as a result of the synergistic interactions between the phytoconstituents contributes to an increase in the overall therapeutic efficacy of the formulation as compared to formulation containing a single-herb. Therefore, standardized polyherbal capsules are effective, scientifically valid, and potentially important in preventive health care or complementary medicine as a viable medication delivery system for herbal products. The increasing interest in and use of these products suggests that there is a demand for safe and natural therapy alternatives to pharmaceuticals. More research, including pharmacological studies, toxicity assessments, bioavailability evaluations, and well-designed clinical trials, must be completed in order to prove their efficacy and safety for humans. Completing such studies would help develop evidence-based phytopharmaceutical products, supporting the integration of herbal medicine into contemporary healthcare practices.

Compliance with ethical standards

Disclosure of conflict of interest

The author(s) declare that there are no conflicts of interest regarding the publication of this work. The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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