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Original Article

Development and Statistical Optimization of Polyherbal Tablets Containing Indigenous Plant Extracts

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Abstract

Background: The study of herbal medicine has grown tremendously in the last few decades. Because of its natural origin and minimal adverse effects. The polyherbal tablet formulation includes significant phytoconstituents like glycosides, alkaloids, Flavonoids, tannins, phenols, steroids, and terpenoids. These substances have a great chance of treating a wide range of diseases. **Objectives:** Development and Statistical Optimization of polyherbal tablets containing *B. diffusa, E. prostrata, P. amarus*, and *S. nigrum* hydroalcoholic entire plant extracts by applying 2^2 factorial design. **Materials and methods:** Selected entire plants were used for the preparation of hydroalcoholic extracts. The wet granulation techniques were used to prepare polyherbal tablets using HPMC, starch, and gelatin as a polymer. **Results:** Selected plant extracts were exposed to preliminary phytochemical investigation, which revealed the presence of steroids, alkaloids, glycosides, tannins, phenols, Flavonoids, and triterpenoids. The preformulation study's results on the granules' various parameters have been shown to be satisfactory. In order to optimize, 2^2 full factorial designs were used, with the amount of MCC (X2) and the amount of gelatin (X1) serving as the independent variables. The examination of hardness 6.125 kg/cm^2 and friability 0.250% revealed that the F2 formulation was the most effective one. **Conclusion:** With an increase in MCC and gelatin content, the tablets' hardness significantly increased. The friability parameters are highly influenced by an ideal concentration of gelatin. When developing herbal tablets, a mixture of gelatin and MCC is the ideal combination of excipients.

Keywords: *Gelatin, Hydroalcoholic extract, MCC, Polyherbal Tablet, wet granulation*

Introduction

Since the beginning of time, people have utilized food and materials produced from plants to treat infectious diseases. For instance, the ongoing study on these plant resources has shown and substantiated their successful demonstration of medicinal efficacy (Ugboko *et al.*, 2020). The discovery and development of current medications have greatly benefited from the bioactive compounds derived from plants. Therefore, it is essential to investigate the medicinal worth of diverse plants on the basis of their pharmacological importance and potential use in various products (Atanasov *et al., 2015*). Research on plants' potential to prevent and cure chronic diseases in humans has increased during the past few decades (Forni *et al*., 2019). In recent years, natural remedies have grown up as vital sources of healthcare for mankind (Pandey *et al*., 2023).

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Standardized and reproducible herbal preparations are desperately needed in the current global market environment. This can be done by creating contemporary herbal dosage forms and evaluating them using advanced techniques. For medications administered orally, solid oral dosage forms are the preferred product class. One advantage is the unit dosage form, which is secure, convenient, simple to manage, and easy to transport. The rationale behind selecting this dose type was its practicality, for administrative convenience and its ability to cover up the taste and odor of herbal extracts (Kushwaha & Kori, 2014). Herbal and Ayurvedic medications contain a variety of chemical components that, when combined, can deliver the desired effect (Bhope *et al.,* 2011). Polyherbal formulation is the use of numerous herbs in one preparation. It provides medicinal efficacy by combining various kinds of herbs. PHF has a narrow therapeutic range, an extensive therapeutic index, and is safe at high doses. It is also effective at low concentrations (Chatterjee *et al*., *2012*). Standardized and reproducible herbal preparations are desperately needed in the current worldwide market environment. This can be achieved by creating conventional herbal dosage forms and evaluating them using innovative techniques (Okhale & EM, 2016). In conventional healthcare systems, a broad range of plants have been shown to be beneficial in the treatment of different systemic diseases. A significant difficulty facing the conventional healthcare system was a lack of comprehensive uniformity, despite the fact that many traditional and indigenous healthcare systems are more successful than the contemporary ones (Petchi *et al*., 2014). *B. diffusa* (Nyctaginaceae), named in Indian medicine as Punarnava, is a perennial creeping herb that spreads throughout India's wasteland. Roots have been claimed to have laxative and diuretic properties and are used to cure cirrhosis and jaundice (Rawat *et al*., 1997). *E. prostrate* is a genus of the family Asteraceae. This tiny annual plant native to South India grows spontaneously in moist areas and has white flowers. The coumestans found in *E. prostrata* are demethylwedelolactone and wedelolactone, both of which possess hepatoprotective properties that promote liver cell regeneration (Chaudhary *et al*., 2011). *P. amarus,* a tropical annual herb in the plant family Phyllanthaceae, has a number of conventional medical uses. *P. amarus* provides a variety of therapeutic qualities, acting as an anti-inflammatory, hepatoprotective, antiviral, antibacterial, along with antimalarial effects (Ogunmoyole *et al*., 2020). *S. nigrum* is a plant in the family Solanaceae that is mostly used in traditional medicine to treat skin and liver disorders. Since ancient times, its leaves and delicate shoots have been utilized as food and are consumed all over the world as vegetables. For newborns with upset stomachs, the plant's infusion is administered as an enema in India (Jani & Ahir, 2010.). The aim of the recent work was to create and evaluate a novel polyherbal tablet formulation with hydroalcoholic entire plant extracts of *B. diffusa, E. prostrata, P. amarus*, and *S. nigrum*. In recent years, natural remedies have grown up as vital sources of healthcare for mankind.

Materials and Methods

Materials

HPMC, starch, gelatin, MCC, magnesium stearate, Talc, ethanol, and Methyl paraben were purchased from Spectrum Chemicals and Reagents Pvt. Ltd., located in Edayar, Cochin. Petroleum ether and ethanol were bought from SDFCL SD fine-chem limited, Mumbai.

Plant materials

Within Tamil Nadu's Kanchipuram District, India, the entire plant of *B. diffusa, E. prostrata, P. amarus,* and *S. nigrum* was collected in Paruthikulam and the surrounding villages. Director of the Southern Regional Center of the Botanical Survey of India, Coimbatore, and Scientist "E," Dr. M.U. Sharief, certified to the identification of these four plants. BSI/SRC/5/23/2021/Tech is the designation on the voucher specimen.

Plant material extraction

The complete set of plant material was washed, dried out in the shade, in addition to ground into a coarse powder using a mechanical grinder with a 40 mesh size. The materials that had been coarsely ground were defatted using petroleum ether, and then macerated in an ethanol and water

combination (70:30 v/v) for seven days while being stirred occasionally. The mixture was filtered after the seven days were finished, concentrated at a suitable temperature (40^{o}C) using a rotating evaporator, dried, as well as kept at a temperature between 4-5^{o}C(Parekh &Chanda, 2007; Anwar *et al*., 2022).

Preliminary Phytochemical Screening of extracts

*B. diffusa, E. prostrata, P. amarus, and S. nigrum*hydroalcoholic extracts were all subjected to a preliminary phytochemical examination using several chemical tests (Shaikh & Patil, 2020).

Preparation of polyherbal tablets

The polyherbal tablets were developed using the wet granulation procedure. Each ingredient in the method, including the standardized extracts, was independently weighed, crushed, and passed through sieve number 80. The starch solution was added gradually and blended with the ingredients. The powder mass was mixed and then run through sieve number 18 to separate the granules, which were then dried in a hot air oven at 60^{o} C. In order to remove any bigger particles, the granules were again passed through sieve number 18, and furthermore, they were placed in desiccators. Entire dried hydroalcoholic plant extracts of *B. diffusa, E. prostrata, P. amarus,* and *S. nigrum* are included in the polyherbal tablet formulation in addition to lactose, HPMC, starch, gelatin, MCC, magnesium stearate, talc, and methyl paraben. For preparing the tablets, a single-punch tablet machine was employed, as shown in Table 1(G. & Reddy, 2017; Gupta *et al*., 2013; Debnath *et al*., 2024).

Table 1. Developing Polyherbal Tablet Formulations

Ingredient (mg)	Batch code					
	B1	B2	B3	B4	B5	B6
Plant Extract	100	100	100	200	200	200
Lactose	90	90	90	180	180	180
HPMC	5	-	-	10	-	-
Starch	-	5	-	-	10	-
Gelatin	-	-	5	-	-	10
MCC	51	51	51	102	102	102
Magnesium stearate	2	2	2	4	4	4
Talc	2	2	2	4	4	4
Methyl paraben	0.1	0.1	0.1	0.1	0.1	0.1
Total weight	250	250	250	500	500	500

Evaluation of pre- and post-compression parameters

The granules that emerged were analyzed for micrometric properties, such as flow property and compressibility index, by measuring bulk density, angle of repose, Hausner's ratio, and tapped density. Organoleptic characteristics and standards for quality control were evaluated for the tablet's friability, average weight, hardness, and disintegration time (Rezghi *et al*., 2021; Sengupta & Zaveri, 2021; Elkhodairy *et al*., 2014).

Hardness test

Tablets must possess a specific level of resistance to impact during handling in all procedures, as well as strength and hardness. Twenty tablets of each formulation were chosen at random, and their hardness was measured using the Monsanto hardness tester.

Percentage friability test

A calibrated Roche friabilator was used to test the tablets' friability. A friability instrument was used to determine the weight loss % of the 20 tablets that were randomly selected from each batch. After four minutes of spinning at 25 rpm, the weight reduction percentage was determined. Friability of less than 1% was considered acceptable.

Statistical optimization of polyherbal tablet

A statistical approach for determining the relative importance of the various components involved in a process is the factorial design. Furthermore, it is possible to identify any interactions between the chosen components. The process of designing a factorial design includes the selection of responses and parameters. Here, 22 complete factorial designs were used. Two concentrations of gelatin (X1) and MCC (X2) were selected to serve as independent variables, as shown in Table 2(Patel *et al.*, 2023; Usman *et al*., 2018; Sammour *et al.,* 2011).

Table 2. Experimental design

Factor details		**Factor level**			
Code	**Variable**	**-1**	**+1**		
X1	**Amount of Gelatin (mg)**	5	15		
X2	**Amount of MCC(mg)**	72	132		
Code	**Dependent variable**	**F1**	**F2**	**F3**	**F4**
Y1	Hardness(kg/cm^2)	6.5	6.0	5.5	6.5
Y2	Friability (%)	0.2	0.3	0.4	0.1

FT-IR Analysis

FT-IR spectroscopy was used to measure the drug's compatibility with the excipients; the aim of the study was to determine whether the excipients' addition altered the chemical composition of the drug. The FTIR spectra of polyherbal tablets and whole plant extracts from *B. diffusa, E. prostrata, P. amarus, and S. nigrum* were obtained in the 4000–400 cm-1 range. After mixing the materials with potassium bromide powder, they were dropped into the sample container, and spectra were obtained. The spectra that differ from the standard value show the peak values and promising functional groups (Siregar *et al*., 2018).

Accelerated stability studies

Tablet stability can be influenced by storage conditions, temperature, light, air quality, and humidity. For six months, accelerated stability testing was carried out with the optimized formulation. Accelerated stability tests were carried out in accordance with ICH guidance. For a maximum of six months, the tablets were maintained at 40 ± 2ºC and 75 ± 5% RH. A variety of characteristics, including color, smell, tablet consistency, average weight, friability, hardness, and disintegration time, were examined under conditions of increased temperature (Puri *et al*., 2018).

Results and Discussion

The extraction was performed for the selected entire plants, *Boerhaavia diffusa, Eclipta prostrata, Phyllanthus amarus*, and *Solanum nigrum*, the percentage yield of extract, color, and consistency (Table 3).

Table 3. Percentage yield of Hydroalcoholic extracts

Plant	**% Yield w/w**	**Colour & consistency**
Boerhaavia diffusa entire plant	12.63	Brown Semisolid
Eclipta prostrata entire plant	13.46	Brown semisolid
Phyllanthus amarus entire plant	15.27	Dark brown Sticky
Solanum nigrum entire plant	12.38	Greenish brown Semisolid

Preliminary Phytochemical Analysis

Qualitative preliminary Phytochemicals were screened in hydro alcoholic extracts. The examination showed the presence of tannins, glycosides, alkaloids, phenols, terpenoids, Flavonoids, and steroids (Table 4).

Table 4. Preliminary Phytochemical analysis of hydroalcolic extract

Phytoconstituents	*Boerhaavia diffusa*	*Eclipta prostrata*	*Phyllanthus amarus*	*Solanum nigrum*
Carbohydrates	-	+	+	-
Alkaloids	+	+	+	+
Glycosides	-	+	+	+
Proteins & Amino acids	+	-	-	+
Tannins	+	+	+	+
Phenols	+	+	+	+
Saponins	+	+	+	+
Flavonoids	+	+	+	+
Terpenoids	+	+	+	+
Steroids	-	+	+	-

(+ Indicates Present) (- Indicates Absent)

Pre compression parameters

Table 5. Pre compression parameters of granules

S.No	Parameters	B1	B2	B3	B4	B5	B6
1	Angle of repose (º)	25.18± 0.061	25.40± 0.024	24.34± 0.058	27.23± 0.047	25.40± 0.032	24.14± 0.025
2	Loose bulk density(g/cm^3)	0.465± 0.010	0.473± 0.033	0.477± 0.003	0.475± 0.014	0.481± 0.016	0.494± 0.021
3	Tapped bulk density (g/cm^3)	0.516± 0.001	0.523± 0.010	0.536± 0.023	0.522± 0.018	0.556± 0.012	0.576± 0.002
4	Hausner ratio	1.17± 0.061	1.16± 0.029	1.10± 0.085	1.21± 0.011	1.22± 0.063	1.18± 0.071
5	Compressibility index (%)	14.43± 0.301	13.62± 0.514	12.68± 0.016	14.92± 0.546	13.62± 1.26	12.8± 0.612

n=3, (± S.D)

The preformulation study's findings on granules' various parameters were considered satisfactory. The granules were assessed for batches (B1–B6), which were used to determine the flow properties and resistance to interparticle friction during particle movement. The prepared granules showed good flow characteristics, according to all the parameters (Table 5).

Assessment of polyherbal tablets

The tablets were evaluated meant for physical appearance, weight uniformity, thickness, friability, hardness, and disintegration time using standard pharmacopeial protocols after development.

Table 6. Post compression parameter results

Parameters	B1	B2	B3	B4	B5	B6
Color	Light brown	Light brown	Light brown	Brown	Brown	Brown
Odour	Distinctive	Distinctive	Distinctive	Distinctive	Distinctive	Distinctive
Form	Circular	Circular	Circular	Circular	Circular	Circular
Texture	Soft	Soft	Soft	Soft	Soft	Soft
Average weight (mg)	249.6±0.52	249.4±0.35	250.2±0.23	499.2±0.36	499.3±0.18	499.6±0.71
Hardness (kg/cm^2)	5.5±0.12	5.0±0.06	6.0±0.04	5.0±0.05	5.5±0.07	6.5±0.12
Friability (%)	0.4±0.03	0.5±0.12	0.3±0.25	0.3±0.54	0.5±0.17	0.2±0.02
Disintegration (min)	14±1.74	14±1.12	13±1.46	13±1.13	13±1.32	12±1.14

n=3, (± S.D)

Every tablet formulation was evaluated using various parameters, and the outcomes were all within the pharmacopoeia limit. There was no significant difference in the tablets' overall appearance. According to the uniform weight test, the tablets all had minimal standard deviation values and were

uniform in weight. Friability and hardness have been shown to be closely correlated; tablets with lower hardness levels also had higher friability (Table 6).

Optimization of polyherbal formulation using 2^2 factorial designs

Table 7. Regression coefficient for hardness

Term	Result	Coef	T-Value	P-Value	VIF
Invariable		6.125	2.80	0.010	
X1 (conc of gelatin)	0.2500	0.1250	2.85	0.032	1.00
X2(Conc of MCC)	0.2500	0.1250	3.02	0.028	1.00
X1 (conc of gelatin)*X2(Conc of MCC)	-0.7500	-0.3750	3.50	0.008	1.00

Table 8. Variance analysis for hardness

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	3	0.68750	0.22917	1.75	0.26
Linear	2	0.12500	0.06250	1.78	0.28
X1 (conc of gelatin)	1	0.06250	0.06250	8.5	0.003
X2(Conc of MCC)	1	0.06250	0.06250	7.65	0.018
2-Way Interactions					
X1 (conc of gelatin)*X2(Conc of MCC)	1	0.56250	0.56250	3.58	0.027
Error	0	0.0604	0.05487		
Total	3	0.68750			

Regression Equation in Uncoded Units

Y1(Hardness(kg/cm2) = 6.125 + 0.1250 X1 (conc of gelatin) + 0.1250 X2(Conc of MCC)
- 0.3750 X1 (conc of gelatin)*X2(Conc of MCC) (eq1)

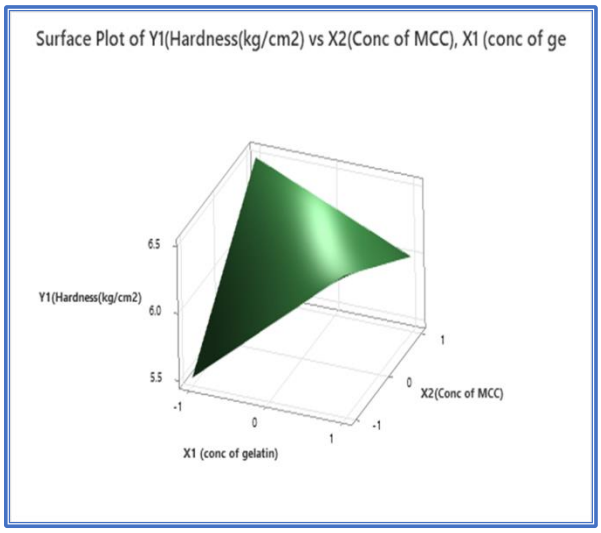

Figure 1. Hardness 3D surface plot response

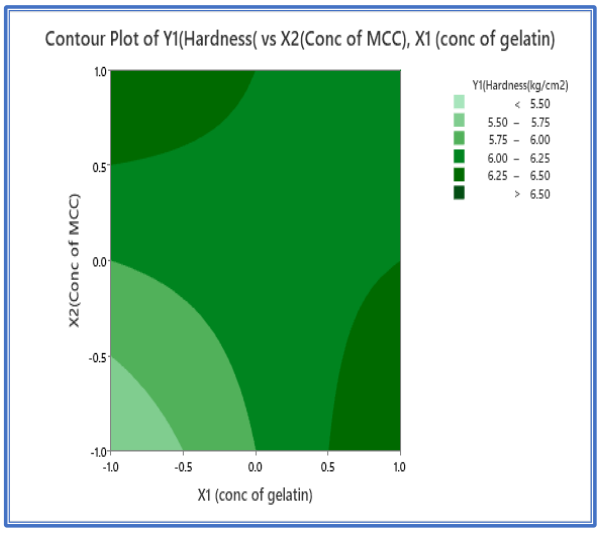

Figure 2. Hardness 3D contour plot response

Table 9. Regression coefficient for friability

Term	Result	Coef	T-Value	P-Value	VIF
Invariable		0.2500	1.80	0.010	
X1 (conc of gelatin)	0.000000	0.000000	1.79	0.032	1.00
X2(Conc of MCC)	-0.10000	-0.05000	2.04	0.018	1.00
X1 (conc of gelatin)*X2(Conc of MCC)	0.2000	0.1000	3.68	0.006	1.00

Table 10. Variance analysis for friability

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	3	0.050000	0.016667	1.75	0.26
Linear	2	0.010000	0.005000	1.78	0.28
X1 (conc of gelatin)	1	0.000000	0.000000	8.5	0.003
X2(Conc of MCC)	1	0.010000	0.010000	7.65	0.018
2-Way Interactions					
X1 (conc of gelatin)*X2(Conc of MCC)	1	0.040000	0.040000	3.58	0.027
Error	0	0.010000	0.010000		
Total	3	0.050000			

Regression Equation in Uncoded Units

Y2 (Friability)(%) = 0.2500 + 0.000000 X1 (conc of gelatin) - 0.05000 X2(Conc of MCC)
+ 0.1000 X1 (conc of gelatin)*X2(Conc of MCC)

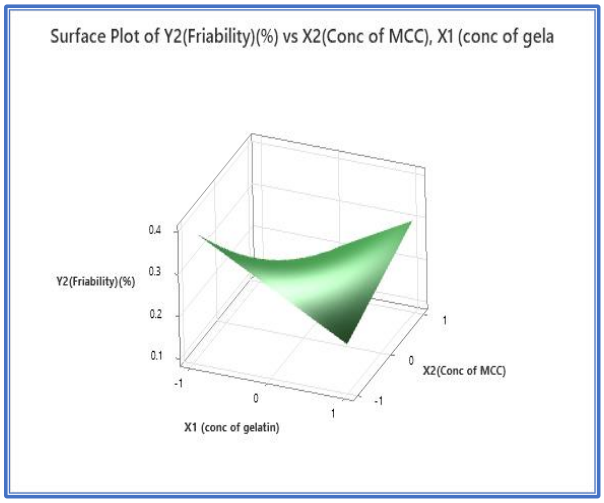

Figure 3. Friability 3D surface plot response

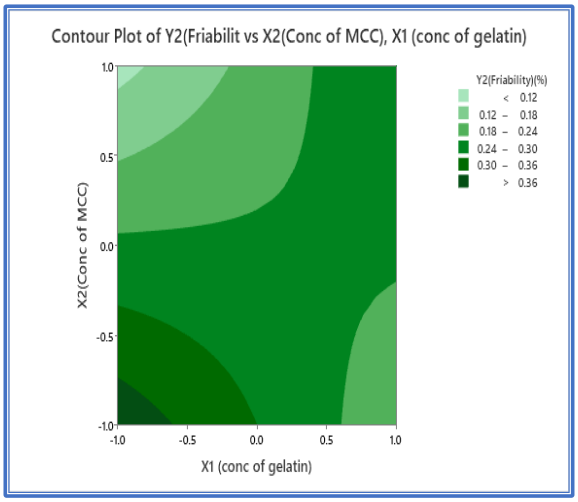

Figure 4. Friability 3D contour plot response

Statistics

The responses of various batches acquired through the use of factorial design are displayed in Table 2 above. The obtained data was analyzed using a second order polynomial equation and submitted to a 2^2 factorial design utilizing DOE software (Minitab).

$$Y= b0 +b\ 1X1 + b2\ X2 + b12\ X1X2$$

When Y represents the dependent variable, b0 denotes the nine runs' arithmetic mean response, and b1 denotes the calculated coefficient for factor X1. The average result of gradually increasing a single factor from a low to a high value is represented by the primary effects (X1 and X2). To explore the impact of independent factors on dependent variables, a 2^2 complete factorial design was used, based on the results of the preliminary trial. Mini Tab was used to create response surface diagrams.

Effect on hardness

When the observed coefficient was fitted, a study was developed to examine the impact of Gelatin and MCC on the hardness of the tablets Eq (1)

$$Y= b0 +b\ 1X1 + b2\ X2 + b12\ X1X2$$

Y1 (Hardness (kg/cm^2) =6.125 + 0.1250 X1 (Conc of gelatin) + 0.1250 X2 (Conc of MCC) - 0.3750 X1 (Conc of gelatin)*X2(Conc of MCC)

The hardness values of the Y1 tablets ranged from 5.5 to 6.5 Kg/cm2, and one study component (X1) showed a significant effect (P = <0.05).

As the amount of MCC with gelatin increased, the tablets' hardness significantly increased as well. The tablet's hardness was mainly attributed to gelatin instead of MCC. The observed relevant coefficient has shown (Table 7&8). The graph was plotted and it has shown in figure no1&2.

Friability-related effect

In order to comprehend how MCC and gelatin concentrations affect tablet friability, a fit was developed in Eq (2)

Y2 (Friability) (%) =0.2500 + 0.000000 X1 (conc of gelatin) - 0.05000 X2(Conc of MCC)

+ 0.1000 X1 (conc of gelatin)*X2(Conc of MCC)

The friability values of tablets Y2 range from 0.1 to 0.4%, indicating that every formulation passed the friability test with success. The ideal concentration of gelatin has a major impact on the friability parameters. That is, a lower friability value. Gelatin and MCC together are beneficial for lowering friability (Table 9 & 10). The graph was plotted and it has shown in figure no 3 & 4.

FT-IR Analysis

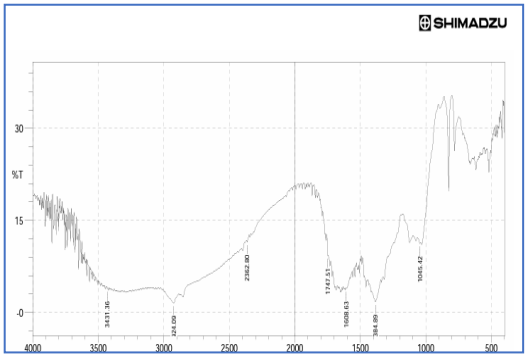

Figure 5. FTIR studies of *B. diffusa* extract

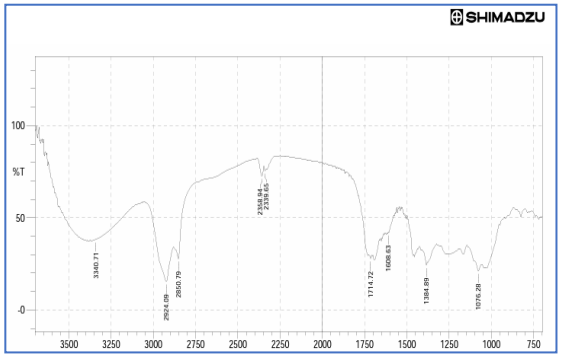

Figure 6. FTIR studies of *E. prostrata* extract

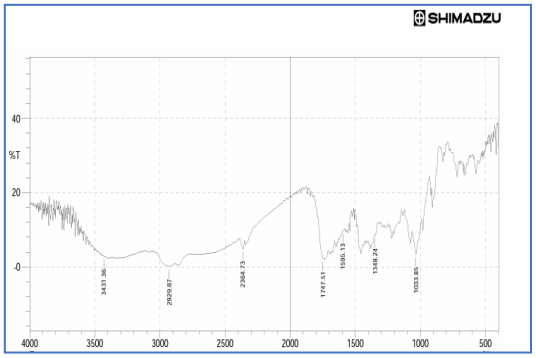

Figure 7. FTIR studies of *P. amarus* extract

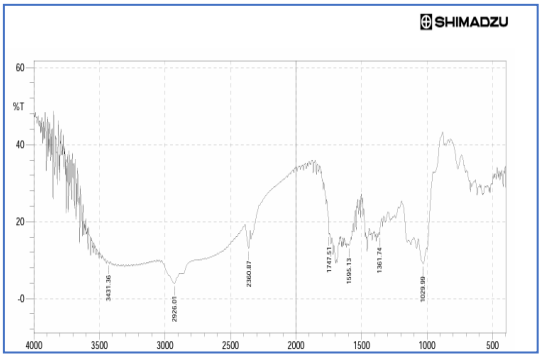

Figure 8. FTIR studies of *S. nigrum* extract

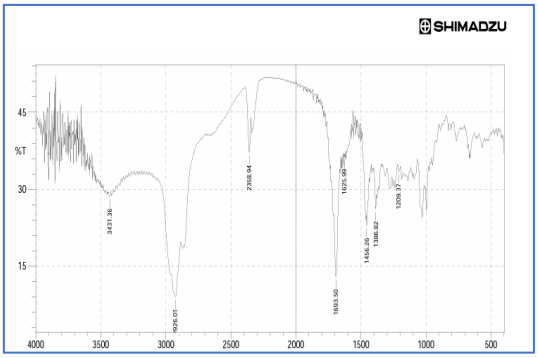

Figure 9. FTIR studies of Polyherbal formulation (PHF)

FTIR experiments were carried out to search used for any exchanges that may occur between the combined extract and excipients in the new polyherbal tablet formulations. Figure 5 displays the *Boerhaavia diffusa* extract FTIR spectra revealed peak of OH stretching at 3431 cm-1, a peak for C=C aromatic flavones at 1608 cm-1, a peak for the C=O group at 1747 cm-1. *Eclipta prostrata* extract of IR spectra revealed peaks of OH stretching at 3340 cm-1, C=C aromatic flavones peak on 1608 cm-1, CH_3 stretching peak at 1384 cm-1(Figure 6). *Phyllanthus amarus* extract FTIR spectra revealed peaks of OH stretching at 3431 cm-1, carboxylate at 1595 cm-1, CH_3 stretching peak on 1348 cm-1(Figure 7). *Solanum nigrum* extract FTIR spectra showed OH stretching peak on 3431 cm-1, carboxylate at 1595 cm-1, CH_3 stretching peak at 1361 cm-1(Figure 8). The polyherbal tablet revealed peaks of OH stretching at 3431 cm-1, CH_3 stretching peak on 1386 cm-1, carboxylic acid peak on 1209 cm-1(Figure 9). There is no sign of a chemical reaction between the extract and the resulting polyherbal tablets' excipients.

Accelerated stability studies

For a period of six months, accelerated stability conditions, including room temperature 40 ± 2ºC and relative humidity 75 ± 5%, were applied to the formulation. With the observed uniformity of weight, hardness, friability, and disintegration time at accelerated temperature settings, there was no discernible change in the physical appearance (Table 11). The developed tablets were found to be stable under the given storage conditions.

Table 11. Accelerated stability studies on the optimized polyherbal tablets

Duration Months	Physical characteristics	Weight on average (mg)	Hardness (cm^2)	Friability (%)	Disintegration time (min)
I	Brown color, circular tablets with a Distinctive odor	500.3±0.71	6.5±1.28	0.2±1.11	12.14±0.83
III	Brown color, circular tablets with a Distinctive odor	501.6±1.21	6.5±0.29	0.3±0.65	13.36±0.86
VI	Brown color, circular tablets with a Distinctive odor	501.4±0.65	6.4±0.15	0.3±1.24	13.30±1.69

n=3, (± S.D)

Discussion

The prepared hydroalcoholic dried extracts were kept in desiccators until they were utilized. The preliminary phytochemical investigation revealed the various hydroalcoholic extracts of the formulation are rich with a variety of phytoconstituents, including steroids, alkaloids, glycosides, tannins, phenols, flavonoids, and triterpenoids (Akmal *et al.,* 2023). Analysed phytoconstituents in various plant extracts of the formulation have been reported to possess medicinal importance in various pathological conditions like laxative, diuretic, cirrhosis, jaundice, anti-inflammatory, antiviral, antibacterial, and antimalarial properties. The functional group of active components present in the formulation is based on band values identified in the FTIR spectrum. The IR spectrum of the polyherbal formulation and its physical mixture with excipients showed the same characteristic bands, indicating no significant interaction between the drugs and excipients used (Elkhodairy *et al*., 2014; Singh *et al.,* 2022). The statistical optimization of polyherbal tablet formulations containing indigenous plant extracts was performed by using 2^2 factorial designs by minitab software. Two factorial designs were used to examine the effect of MCC and gelatine on friability and hardness of tablets. Both the substance showed significant effect on hardness and friability. The examination of hardness and friability revealed that the F2 formulation was the most effective one. Its hardness and friability are within an acceptable range, and its hardness, regression coefficient was 6.125 kg/cm^2 and its friability regression was 0.250% (Tanisha *et al*., 2024). The research findings of the study suggest that the utilization of polyherbal tablet formulation contains rich phytoconstituents significantly enhance the synergistic activity.

Conclusion

The phytochemical results of this investigation revealed many secondary metabolites, such as Flavonoids, terpenoids, tannins, phenols, alkaloids, and glycosides, are present. The granules from six batches' pre-compression parameters showed that the flow properties were good. The extracts are compatible with excipients, according to the FT-IR studies. The post-compression results for every batch were verified to comply with the standards. The experimental software design was utilized for applying the 2^2 factorial designs. The results of the evaluation parameters performed were better in the F2 formulation. After a six-month storage period, the improved formulation's stability investigation showed consistent results. The outcomes of this study indicate that by combining traditional knowledge and modern technologies, medicinal plants can be developed into an affordable tablet formulation to improve their stability, user compliance, and acceptance.

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Conflicts of Interest

We declare that there is no conflict of interest.

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