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Research Article

Assessment of Quality Control parameters under Accelerated Stability Conditions for Manasamitra Vatakam; A Herbo Mineral Formulation

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Abstract

Accelerated Stability Studies predicts the stability data and significantly explains the drug decision process. In the present study, Manasamitra Vatakam, a Herbo mineral formulation was subjected to stability conditions at 40°C ± 2°C /75%± 5% RH for 06 months. Control and stability samples were determined for parameters like Weight variation, Moisture content, Marker content determination, and Disintegration test, Dissolution study with different mediums, Friability and Hardness test. The phytomarker analysis showed decrease assay value for β-sitosterol, Vitexin, Kampferol and Withaferin. The dissolution studies were performed for the major biomarker Berberine in 0.1N HCl, pH 4.5 acetate and pH 6.8 phosphate buffer in which pH 6.8 buffer showed maximum release of 66.82% at 04 hours. The other Quality control parameters showed minimal difference under acceptance criteria. The study explains the need of stability analysis in polyherbal formulations and developed method can be used for routine analytical studies in various formulation containing berberine.

Keywords: Berberine, HPLC, Manasamitra Vatakam, Quality Control, Stability.

INTRODUCTION

Etymologically speaking, Ayurveda is the combination of the Sanskrit words ayur (life) and veda (science or knowledge), which means “the science of life,” focusing on bringing harmony and balance in all areas of life including mind, body and spirit[1]. The traditional system of medicine generally involves the utilization of plants or herbs as the core for the overall cause rather than the particular ailment [2]. The major contribution was initiated when the ethnobotanicals are used for the pharmacological activities and also these herbs are used as the starting materials which laid the foundation for the drug discovery and development of the active compound. It was discovered throughout the research process that the extracted active chemicals may be processed and delivered in insignificant doses independent of the age or source of the plant material obtained [3]. Manasamitra Vatakam, is an eminent classical formulation, officially texted in Sahasrayogam for the treatment of anxiety, epileptic disorders and manic illness. The formulation itself contains heavy metals, which are quite helpful in treating post-synaptic epileptic syndromes, and the minerals present contains have antioxidant properties[4]. Even though the traditional authenticated methods like morphological and microscopic methods seems to be low cost and simple methods still requires the skilled herbalists for attaining accuracy and reliable results [5]. The major focus has been done on performing the virtual screening of the molecular biology libraries which help in the further identification of newer compounds though the safety of the compounds still remains undetermined [6].

Herbal regulatory agencies have varying regulatory criteria that are mostly categorised as "health claims" or "medicinal claims," and they vary by nation, resulting in a lack of sophisticated scientific understanding of plants [7]. Apart from all of this, another significant problem for herbal formulations is the failure to maintain sufficient quality control criteria. Regardless of the formulae indicated in the official compendia, a wide variance in the production process from manufacturer to manufacturer, batch to batch followed throughout the preparation protocol was discovered, resulting in a lack of quality standards. Hence most of the ayurvedic herbal

formulation fails to meet the uniformity in dosage forms during the manufacturing and thus preparation of an herbal drug has become a challenge to the manufactures and become a major obstacle in the herbal drug standardizations. It should be completely understood that though the herbal products are derived from nature it can't be considered to be safe as the term "safety" and "natural" are not synonyms [8].

WHO has attempted the approach of drug use indicators in Ayurvedic Science and adopted few modifications to render the clarity on various components of herbal drugs. The herbal polyherbal formulations were classified as (a) Classical Ayurvedic Drugs, (b) Proprietary Ayurvedic Drugs, (C) Ayurvedic *rasa* drugs. Classical formulations are those which have some ayurvedic reference in the ancient classical text and were manufactured under same name and composition stated without any clinical investigation. All these formulations are availed in Ayurvedic Formulary of India (AFI). These formulations are also called as Generic formulations but the term generic is in contrary when said about allopathy. Proprietary medications are chemical compositions with no substantial reference and are not specified in AFI. These formulations are developed by the pharmaceutical companies and they avail a proprietary right for marketing. Another category of ayurvedic drugs used were *rasa* implies these are the herbo metallic preparations manufactured by incorporating mercury as an essential component. These are majorly used for the study purpose [9].

The shelf life generally varies and gets influenced with the change in climatic conditions, harvesting, biological variation in species thus results in low marker content determination. Hence in view of this into account the specified range for any marker can vary from 100% ± 10% from the initial assay value, but less than 10% of deviation should be considered as a serious challenge [10].

Despite of its wide acceptability and availability, herbal products are not tested for meeting its quality criteria as per regulatory requirements. Rather than assessing its therapeutic efficacy the major challenge face by herbal industries is its shelf life and chemical quality during degradation. As far of herbal products are concerned, its shelf lives procedures are mentioned in Department of AYUSH, Ministry of Health and Family welfare and Drugs and Cosmetic's Act though its documentation proof is not available in any gazette [11].

The actual need of stability studies is to determine and document the evidence for the variation in the quality of the product with time with the factors like temperature, humidity and light. According to ICH guidelines Stability testing not only reveals the quality of the product but also details the intrinsic solubility of the molecule [12]. The parameters for conducting stability studies should identify the characteristics that are vulnerable to changing the quality, potency, safety, and efficacy under storage circumstances. The storage conditions for maintain the accelerated stability study includes 40 °C ± 2 °C / 75 % RH ± 5 % RH for the time period of 06 months. The testing frequency includes a minimum of three time point study i.e., 0, 3, and 6 months respectively. In any exceptional study a fourth time point with extra sample load can be performed. Occasionally data from the accelerated studies can be implemented to define the effect of product quality in short term excursions occurred during shipping or transportation. Upon successful storage of the samples at the given storage conditions, they should be studied for the determination of organoleptic characters, quality control parameters, assay limits and related substances (if necessary) respectively [13,14].

The parameters for conducting stability studies ought to identify the characteristics that are vulnerable to changing the quality, potency, safety, and efficacy under storage circumstances. The present study mainly focused on performing the accelerated stability studies at 03point interval starting from initial study for the herbo mineral formulation Manasamitra Vatakam, to determine the quality control parameters and analyse the stability data. In the present analysis, MMV was subjected to the following quality control parameters according to the United States Pharmacopeia (USP). Weight variation test / Uniformity of weight, Estimation of the drug content i.e., for the identified markers (Assay), Disintegration test, Dissolution test (Dissolution Profile in different mediums [DPDM study]). The unofficial tests include the following Hardness test, Friability test, Determination of moisture content.

EXPERIMENTAL APPROACH

Chemicals and Reagents

HPLC grade Methanol and Acetonitrile, Formic Acid, Hydrochloric acid, Glacial acetic acid, Sodium Hydroxide, Sodium Acetate, Potassium Dihydrogen Phosphate of analytical grade were used for analytical preparation. A 0.45 m membrane filter was used to vacuum filter the mobile phase. Phytomarkers Stigmasterol, Lupeol and β-sitosterol were purchased from M/S Natural Remedies, Bangalore. Gallic Acid, Ellagic Acid, Quercetin, Rutin, Vitexin, Andrographolide, Kampferol, Apigenin, Withaferin and Berberine were procured from Sigma Aldrich.

Experimental conditions

The samples were evaluated using an HPLC Shimadzu Prominence model coupled with an LC20AD binary solvent delivery module, and SPD M20A PDA detector, a Rheodyne injector (model 7125, USA) valve with a 20 l loop, as well as a CT0-20A column oven. The system was controlled by a controller module configured with a CBM-20A Communications Bus Module, and data gathering was configured using Lab solutions software (7.1 Version). Separation and quantification were performed on a Phenomenex C18 column with a maximum wavelength of 266 nm. MS Excel 2010 was used for the data analysis and statistical calculations.

Buffer Preparation

0.1N HCl- To 850 mL of distilled water, 8.5 mL of 37% hydrochloric acid was added, vortexed well for homogeneous mixing, and made up to 1000 mL with water. The dissolution medium of 10L was prepared in a single lot for the complete analysis.

Preparation of pH 4.5 Acetate Buffer- Accurately weighed and transferred 29.99gm of sodium acetate to 7L of distilled water and uniformly mixed. To this solution added 14.5 mL of 2N glacial acetic acid solution and made up to the volume to 10L and thoroughly mixed. If necessary, the pH was adjusted to pH 4.5 with 0.1N sodium hydroxide.

Preparation of pH 6.8 Phosphate Buffer - 250 mL of 0.2M monobasic potassium dihydrogen phosphate and 112 mL of 0.2N sodium hydroxide solution were added to a 1000 mL beaker and uniformly mixed before being brought to volume with distilled water and the pH of the solution was tested.

PROCEDURE FOR QUALITY CONTROL DETERMINATION

Weight Variation Test

Twenty tablets were chosen at random from the pooled sample matrix, and the individual weight of each tablet was recorded for all of them. The maximum and lower limits were obtained by calculating the mean average weight of all the tablets. Individual weights were confirmed at the maximum and lower limits to govern the weight variance that existed. The parameter is ensured by ensuring that NMT two tablets out of twenty are within the average weight error range and do not exceed the % restrictions.

Uniformity of Dosage form

The assay content in ayurvedic medicines is difficult to identify since it changes from plant to plant, season to season, and manufacturer to manufacturer. As a result, the quantity of the marker calculated from the herbal doses is based on the amount contained in µg/mg marker in the primed extract [15]. Ten tablets were chosen at random and their average weight was recorded. The appropriate concentration range of methanolic extract was prepared. The prepared matrix was filtered, and the filtrate was treated to a specific assay protocol and assessed using the HPLC methodology as described in the preceding section. The % assay limits were within the authorized range.

Disintegration Test

The test is performed by placing each tablet in the basket impregnated with disc (disintegration media: 0.1N HCl, temperature: 37 ± 0.5 °C). The approximate time taken until no residue of the tablet remains in the basket was recorded as the disintegration time of the tablet [16].

Dissolution Test

A tablet dissolution test was performed according to USP to determine the percentage drug release for the specified marker in the formulation. Because ayurvedic formulations are alleged to release drugs slowly, the process of dissolution employed in MMV analysis was based on the sustained release method. Dissolution test is considered as one of the integral tools in the determination of in vitro bioavailability. The dissolution test was performed at three different medium i.e., Dissolution Profile with Different Medium (DPDM) study. The USP type II i.e., paddle, 900 mL of dissolution medium (0.1N HCl pH 4.5 acetate buffer and pH 6.8 phosphate buffer) were selected to maintain the appropriate sink condition. The RPM was maintained at 75 with the bowl temperature of 37 ± 0.5 °C. 5 mL of the aliquots was withdrawn at predetermined time intervals and filtered accordingly. The filtrate was subjected to HPLC analysis which was given below. The withdrawn sample was replaced with the fresh media to maintain the sink condition. Six determinations were performed for each tablet from which the cumulative drug release for the dosage form was calculated and plotted against function of time to study the extent of drug release [17-19].

Chromatographic Conditions

To calculate the percentage drug release of berberine from 0.1N HCl as dissolution media, 0.1% (v/v) formic acid in water was used as mobile phase. For pH 6.8 phosphate buffer as dissolution media, water and ACN in the ratio of 55:45% v/v mixed with the flow rate of 1.0 mL min-1 using Phenomenex C18 column as a stationary phase with the detection max at 266 nm was employed [20-22].

Monsanto Hardness Test

The tablet hardens was well intended to study the strength to withstand the mechanical shocks during transporting. The hardness of the tablets generally reveals the tablet crushing strength. Monsanto hardness was used to study the hardness of the tablet with five determinations and the limits should be between 4 kg to 6 kg.

Friability Test

The friability test was performed on friabilator FT20, Lab India Pvt Ltd. The test was performed to determine the percentage weight loss of the tablet during the mechanical shaking or during the exportation of the batches. Randomly 20 tablets were selected for the analysis and the initial weight (W_1) was recorded and the tablets were subjected to 100 revolutions per min in the friabilator for 4 min followed by the determination of the final weight (W_2). Compressed dosage that loses less than 0.5 to 1.0 percentage of the Tablet weigh are considered satisfactory.

Determination of Moisture Content

Shimadzu moisture balance was employed to assess the moisture content found in the herbo mineral formulation. The idea is analogous to the loss on drying, except that the moisture analyser applies an initial weight of the sample. The halogen moisture heater in the analyser eliminates excess moisture through the emission of heat, i.e., a program was set to 110 °C. After completely removing the moisture from the sample, the application displays the percentage of moisture contained in the sample, which was eventually recorded [23-26].

Accelerated Stability Study Analysis

The accelerated stability studies use the exaggerated storage conditions i.e., 40 ± 2 °C and 75 ±5 % relative humidity to increase the rate of chemical and physical degradation to determine the tentative shelf life. As a

result, the data generated helps in maintaining the correlation between the extent of degradation and the storage conditions. The accelerated stability study was performed on REMI SC++ stability chamber, where the sampling points were kept as initial, 01, 03 and 06 month analysis period. The measures used for the stability examination include the tablet's appearance, assay, uniformity of weight, disintegration, dissolution, and hardness, as well as a friability study and moisture content assessment. The samples were loaded using a thorough stratification strategy for the evaluation of all parameters, and the draw out time points were set up in line with established guidelines.

RESULTS

Manasamitra Vatakam was subjected to accelerated stability conditions, and the quality control parameters were investigated and addressed.

Weight Variation Test

The initial weight variation investigation revealed an average weight of 185 mg, with lowest and maximum weight variations of 179 mg and 194 mg, accordingly, with percentage deviations of -3.352 and 4.639. In accordance to the pharmacopeia, the uniformity of weight might vary up to 7.5% for tablet weights ranging from 80 mg to 250 mg. As an outcome of the findings, it was concluded that none of the tablets tested deviated from the limit that was set. As a result, the weight variation test for the herbo mineral formulation was confirmed to be within compendial limitations. Thus, the weigh variation test was determined to be satisfactory for the mentioned herbomineral formulation, and the results are shown in table-1.

Table 1: Weight variation and deviation of MMV under Accelerated stability conditions

S. No	Initial		1st Month		3rd Month		6th Month	
	Wt. of tablet	Percentage Deviation	Wt. of tablet	Percentage Deviation	Wt. of tablet	Percentage Deviation	Wt. of tablet	Percentage Deviation
01	0.185	-0.514	0.176	-2.045	0.173	-2.052	0.183	4.235
02	0.191	3.141	0.181	0.773	0.172	-2.616	0.175	0.000
03	0.184	-0.543	0.184	2.391	0.182	3.022	0.176	0.568
04	0.179	-3.352	0.173	-3.815	0.181	2.486	0.170	-2.941
05	0.186	0.538	0.169	-6.272	0.175	-0.857	0.176	0.568
06	0.189	2.116	0.180	0.222	0.176	-0.284	0.176	0.568
07	0.194	4.639	0.183	1.858	0.172	-2.616	0.172	-1.744
08	0.192	3.646	0.184	2.391	0.176	-0.284	0.171	-2.339
09	0.183	-1.093	0.186	3.441	0.179	1.397	0.173	-1.156
10	0.186	0.538	0.171	-5.029	0.180	1.944	0.179	2.235
11	0.193	4.145	0.173	-3.815	0.173	-2.023	0.172	-1.744
12	0.186	0.538	0.179	-0.335	0.176	-0.284	0.182	3.846
13	0.188	1.596	0.188	4.468	0.172	-2.616	0.174	-0.575
14	0.181	-2.210	0.185	2.919	0.173	-2.023	0.177	1.130
15	0.186	0.538	0.183	1.858	0.179	1.397	0.172	-1.744
16	0.182	-1.648	0.186	3.441	0.181	2.486	0.170	-2.941
17	0.181	-2.210	0.174	-3.218	0.183	3.552	0.183	4.372
18	0.182	-1.648	0.179	-0.335	0.176	-0.284	0.174	-0.575
19	0.188	1.596	0.176	-2.045	0.177	0.282	0.178	1.685
20	0.183	-1.093	0.182	1.319	0.175	-0.857	0.172	-1.744
Avg.	**0.186**		**0.180**		**0.177**		**0.175**	

Uniformity of Content

The above-mentioned processes were used to ensure content uniformity. However, the compendial limitations were not indicated in the manufacturing process of the herbal formulations, posing a significant obstacle in calculating the assay value for each chemical marker detected. Because there is no defined limit for the presence of individual markers in each plant extract, the quantity of markers detected during the HPLC analysis is known as the formulation's content and were recorded for further documentation. The amount of chemical markers found were given under table-2.

Disintegration Test

The disintegration test is considered as one of the prime aspects in the manufacturing of the tablets as it effects the bioavailability of the drug and its absorption rate. The disintegration test deals with disintegrating the tablet into fine particles into the dissolution medium i.e., 0.1N HCl. The total disintegration time taken was 27.33 min for the formulation and was found to be within the limits.

Dissolution Test

The formulation was analysed for the major marker i.e., Berberine and the cumulative drug release for the identified marker was analysed and the test was carried out for 24hrs at 0.1N HCl, pH 4.5 acetate buffer and pH 6.8 phosphate buffer. The percentage drug release was calculated at different sampling intervals i.e., 0, 5, 10, 15, 30, 45, 60, 90 min, 2hrs, 4hrs, 6hrs, 8hrs, 10hrs, 12hrs and 24hrs respectively.

Table 2: Content Uniformity of markers analysed under Accelerated Stability conditions by RP- HPLC-Method

Assay Parameters	Initial (ug/ mg)	1st Month (ug/ mg)	3rd Month (ug/ mg)	6th Month (ug/ mg)
Lupeol	31.4	30.67	29.26	30.14
Stigmasterol	51	50.21	48.11	48.36
Sitosterol	56.3	54.83	52.37	50.77
Gallic Acid	70.22	71.87	67.23	69.21
Ellagic Acid	21.03	20.21	22.1	20.82
Quercetin	20.37	21.17	20.19	19.67
Rutin	81.76	79.44	80.32	78.34
Vitexin	13.71	13.24	13.64	12.56
Andrographolide	10.26	9.97	11.01	11.21
Kampferol	15.81	15.67	15.89	14.37
Apigenin	5.71	5.86	5.97	5.74
Withaferin	13.03	12.63	13.57	11.94
Berberine	344.01	344.27	340.24	341.2

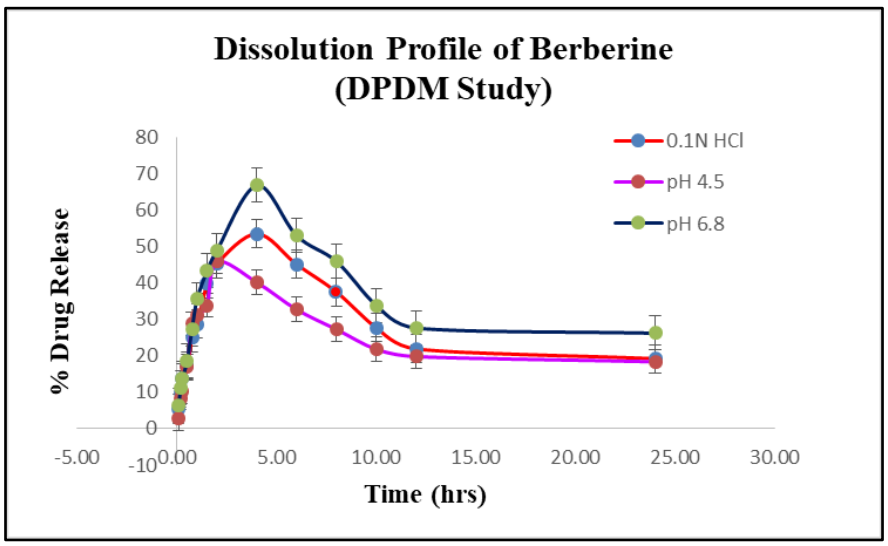

Figure 1: Percentage DR of Berberine in MMV by DPDM study

The quantification was done using RP-HPLC method. Of which the maximum drug release was found at 4th hour in both 0.1N HCl and pH 6.8 phosphate buffer i.e., 53.59 % and 66.85 % respectively whereas for pH 4.5 acetate buffer it was 45.87 % at 2nd hour. Based on the drug release of berberine in the dissolution media, it was discovered that the basic medium, i.e., pH 6.8 phosphate buffer, had the highest drug release of 66.85% of all the mediums. After reaching the maximum release point, the parabolic curve began to decline gradually.

Table 3: Percentage Drug Release of Berberine in Dissolution Medium by HPLC-Method

Time	0.1N HCl	pH 4.5 (Acetate)	pH 6.8 (Phosphate)
5 min	5.45	2.81	6.55
10 min	9.86	8.48	11.12
15 min	13.88	10.33	13.75
30 min	17.33	17.03	18.62
45 min	24.98	28.88	27.47
1.00 h	28.69	31.1	35.57
1.30 h	39.77	33.93	43.42
2.00 h	45.41	45.87	49.04
4.00 h	53.59	40.21	66.85
6.00 h	45.16	32.75	53.05
8.00 h	37.57	27.29	45.96
10.00 h	27.77	21.82	33.93
12.00 h	2194	19.83	27.67
24.00 h	19.25	18.42	26.25

DISCUSSION

The complete drug release at each sampling interval was specified in table– 3 and the parabolic curve was depicted in figure-1. In acetate buffer, the tablet's early disintegration was exceedingly sluggish, regardless of its drug release time of 2 hours. On comparison of the percentage drug release from all the three disso mediums pH 6.8 phosphate buffer has shown better release followed by 0.1N HCl and pH 4.5 acetate buffer. The results were quite interesting with the change in different pH mediums. With respective of the percentage drug release in all the pH mediums, 0.1N HCl and pH 6.8 phosphate buffer was expected to have maximum drug release and thus the two dissolution mediums were selected for the accelerated stability conditions.

The other quality control parameters like hardness, friability and moisture content were performed as per the protocol stated in the USP and the results were found to be satisfactory i.e., hardness of the tablet was found to be 4.52 kg, the percentage weight loss during friability takes the value of 0.08 and the percentage moisture content was found to be 2.87 % during the initial month of the study. All the quality control parameters were in the satisfactory range and presented in table-4.

Table 4: Quality control parameters studied under accelerated conditions

Parameters Studied	Initial	1st Month	3rd Month	6h Month	Limits
Hardness (Kg)	4.52	4.86	4.51	4.30	04-06
Disintegration (min)	27.33	28.01	25.83	24.29	NMT 30min
Friability (%)	0.08	0.14	0.12	0.27	NMT 1%
Moisture content (%)	2.87	3.61	5.49	6.87	NMT 10%

Chromatographic Elution of Berberine

Berberine was eluted with the retention time of 5.855 min in 0.1N HCl medium and at 4.921min in pH 6.8 phosphate buffer respectively. The standard chromatograms and the sample chromatograms of both the pH buffers were represented in fig 2 and 3. The linearity profile was drawn and the calibration curve for 0.1N HCl and pH 6.8 phosphate medium at the concentration range of 5-120 µg/mL and 22-712 µg/mL respectively and the regression coefficient was found to be within specified limits. The drug release of Berberine was calculated from the regression equation and all the calculations were done using MS Excel office.

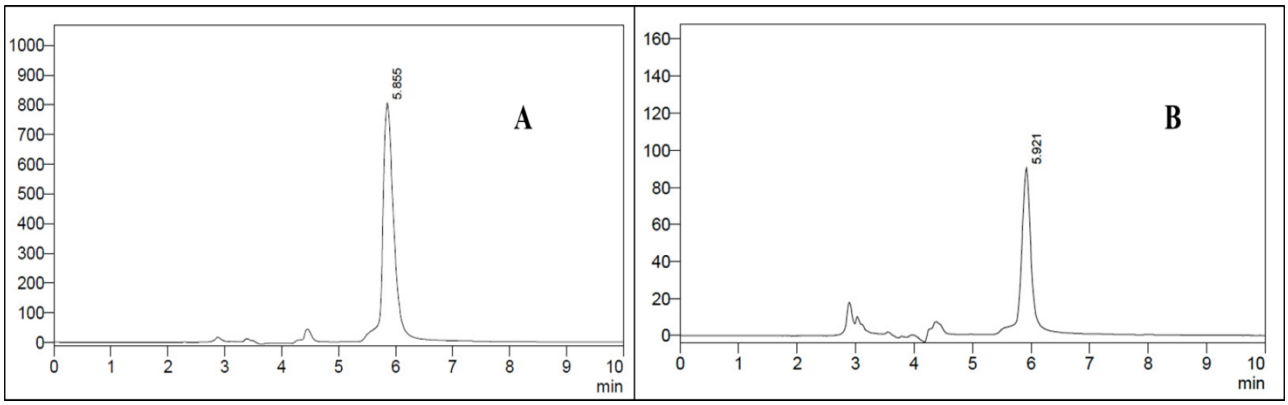

Figure 2: (A) Standard chromatogram and (B) Sample chromatogram of Berberine in 0.1N HCl

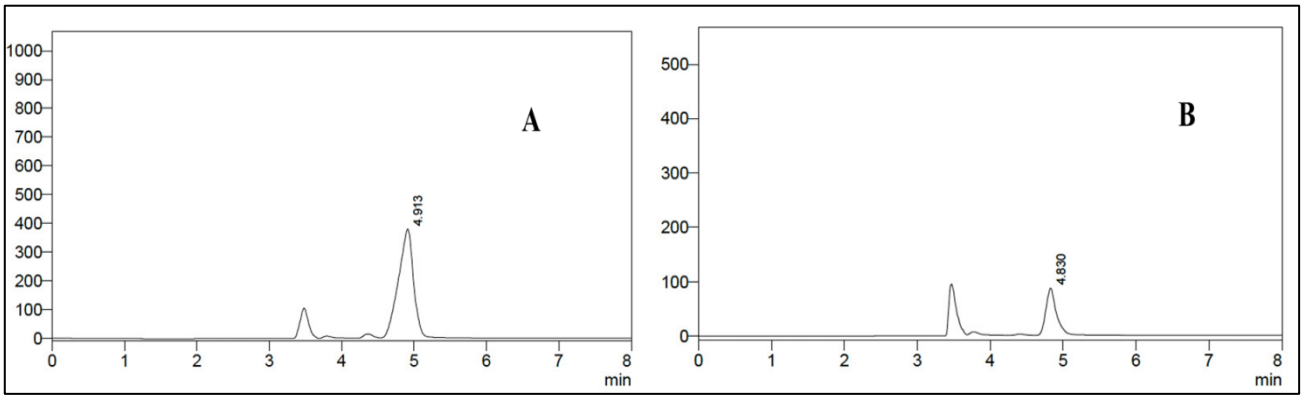

Figure 3: (A) Standard chromatogram and (B) Sample chromatogram of Berberine in pH 6.8 Phosphate buffer

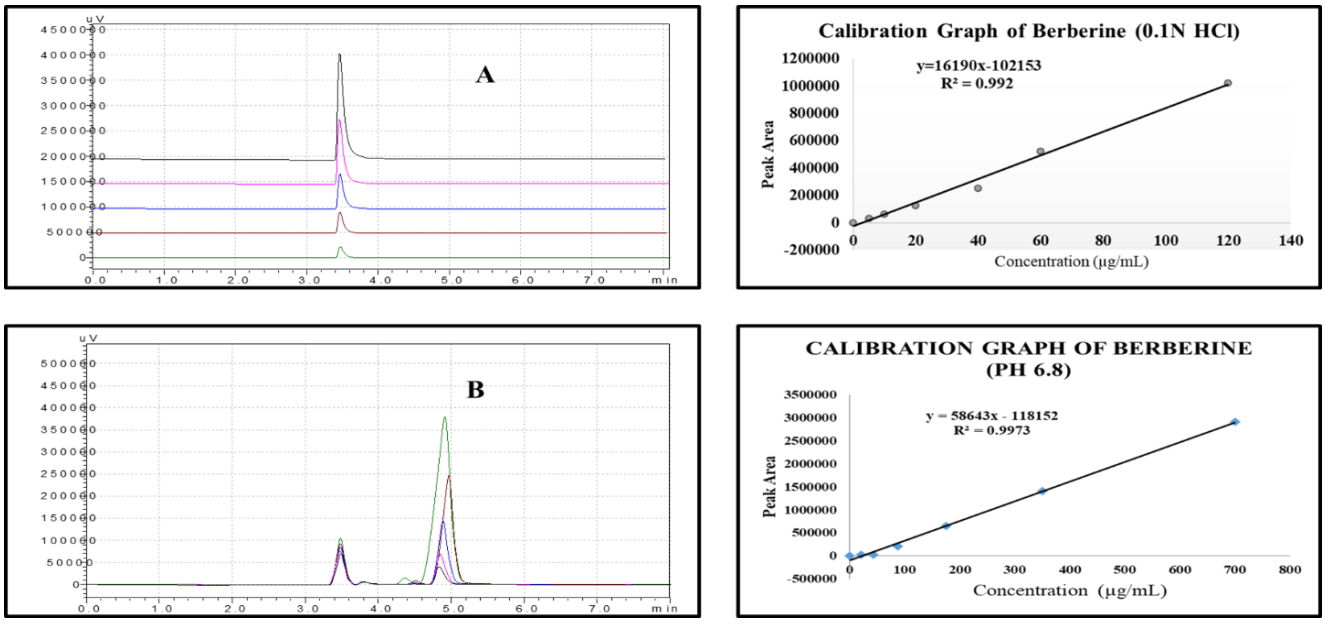

Figure 4: (A) Linearity Overlay of Berberine in 0.1N HCl and its Calibration Curve, (B) Linearity Chromatogram of Berberine in pH 6.8 Phosphate Buffer and its Calibration Curve

Accelerated Stability Study of MMV at 40 ± 2 °C and 75 ± 5 %RH: To test the product deterioration, the formulation was loaded for accelerated stability studies. Although many traditional formulations are of plant origin, the level of degradation must be investigated in order to identify potential degradants and to assure the strength, quality, and purity of the dosage forms. Any dosage form, such as gutika or vati, has a storage period of 05 years, according to "Gazette notification GSR No. 789 (E)." (Thomas et al, 2019). Consequently, deterioration under storage conditions may negatively impact the tablet's efficacy. Following this approach, the samples were evaluated at all required time intervals, notably at 0, 1, 3, and 6 months for all of the quality control standards stated and the outcomes were recorded in table 5.

Table 5: Percentage Drug Release of Berberine in 0.1N HCl and pH 6.8 Phosphate Buffer under Accelerated Conditions

Time	0.1N HCl				pH 6.8 Phosphate Buffer			
	Initial	1M	3M	6M	Initial	1M	3M	6M
5 min	5.45	5.36	5.32	5.21	6.55	6.48	6.45	6.32
10 min	9.86	10.78	10.81	10.26	11.12	12.26	12.28	12.08
15 min	13.88	12.80	12.57	12.07	13.75	13.33	13.73	12.99
30 min	17.33	18.85	17.94	18.03	18.62	17.53	18.73	17.37
45 min	24.98	26.60	25.62	24.28	27.47	26.78	26.08	24.04
1.00 h	28.69	28.88	29.41	28.09	35.57	30.49	29.71	28.43
1.30 h	39.77	39.67	39.02	36.75	43.42	41.56	42.13	40.93
2.00 h	45.41	46.52	45.15	43.63	49.04	46.59	48.50	47.34
4.00 h	53.59	50.11	48.79	47.36	66.85	61.60	62.50	58.28
6.00 h	45.16	40.05	38.18	36.93	53.05	49.29	50.53	46.53
8.00 h	37.57	29.38	29.93	29.05	45.96	44.66	44.51	41.69
10.00 h	27.77	26.88	24.74	23.83	33.93	34.86	34.76	31.85
12.00 h	21.94	22.34	22.55	21.99	27.67	26.64	27.47	25.59
24.00 h	19.25	20.24	18.57	16.23	26.25	25.22	25.83	23.91

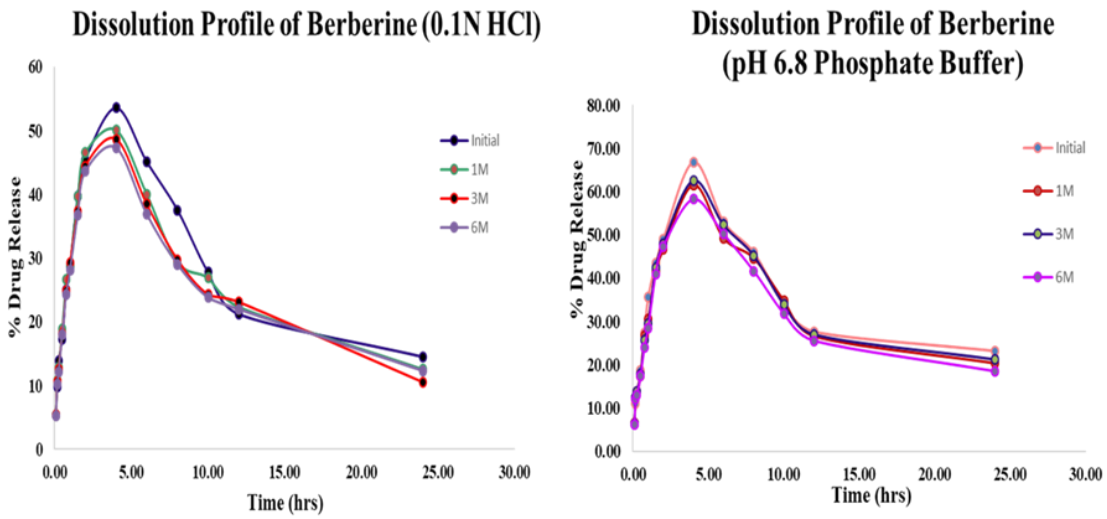

Figure 5: Comparative Percentage Drug Release of Berberine in 0.1N HCl & pH 6.8 Phosphate Buffer under Accelerated Stability Conditions

The stability of any dosage form can be affected on long storage like it may be due to contamination with microorganisms, entrapment of moisture which alters its therapeutic efficacy. Hence, every pharmaceutical product whether allopathic medication or any herbal medications need to be emphasized on the stability protocol and suitable temperature conditions to be maintained to perform the stability analysis [24]. For the study of MMV accelerated stability study was included which enables to control the product attributes like moisture content, drug disintegration pattern, hardness of the dosage form and other quality control parameters [25,26]. The calibration curve was constructed with the respective buffers as diluent and the r^2 value was found to be more than 0.99 for both the dissolution mediums and the HPLC chromatograms along with the calibration curve was depicted in figure 4. The dissolution profile at each stability interval was performed for 0.1N HCl and pH 6.8 phosphate buffer and the comparative percentage drug release of berberine was tabularized in table 5 and represented in figure 5. With all the data in evidence there was found no significant change in the quality control parameters of Manasamitra Vatakam upon storage under accelerated stability conditions.

CONCLUSION

All of the quality control parameters specified in the pharmacopeia were examined and determined to be within acceptable ranges. The stability study revealed greater understanding of the formulation in relevance with the quality assurance standard of the ayurvedic medicine Manasamitra Vatakam. To test the product deterioration, the formulation was loaded for rapid stability studies. The deterioration of the tablet for storage conditions may affect its efficacy. The samples were investigated at all requisite time intervals, i.e., 0, 1, 3, and 6 month assessment for all the quality control parameters indicated, and the outcomes recorded revealed minimal to no substantial modifications and all acquired values were within prescribed limits. The assay was performed for all of the determined markers, with an assay decline in value of more than 2% noticed for β-sitosterol, Vitexin, Kampferol and Withaferin. At the conclusion of the sixth month evaluation, the percentage drug release was reduced partially in both buffers, resulting in 47.36 and 57.28% Berberine in 0.1N HCl and pH 6.8 Phosphate buffers, respectively. The stability studies were carried out, and it was discovered that the deterioration was within the specified limit range according to the compendial criteria.

Conflict of Interest: The authors declare that there is no conflict of interest.

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