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FORMULATION DEVELOPMENT AND EVALUATION OF POLYHERBAL SUSPENSION CONSISTING OF *ADOXA MOSCHATELLINA*, *ALPINIA GALANGA* AND *LAURUS NOBILIS*

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ABSTRACT
Ayurveda is one of the oldest systems of human medicine and is referred to as Science of life. Due to the therapeutic advantages, affordability and lack of harmful effects, medicinal plants are highly preferred in treatment of various diseases and ailments and thus are subject of extensive study throughout the world. Thus, evaluation and standardization of herbal formulation is the most crucial part in assessing the quality of drugs prepared. The present study outlines the preparation and standardization of polyherbal formulation comprising of *Adoxa moschatellina* (AM), *Alpinia galanga* (AG) and *Laurus nobilis* (LN). The developed suspension was found to have adequate Organoleptic characteristics such as odour, taste, colour, moisture content, ash value as well as physical parameters such as particle size, pH, sedimentation rate, redispersibility of suspension, stability of suspension, rheology and viscosity of PHF thus concluding that the suspension formulated is safe and effective for use.

KEYWORDS: Polyherbal formulation, Formulation and evaluation, *Adoxa moschatellina*, *Alpinia galanga*, *Laurus nobilis.*

1. INTRODUCTION

The plants with medicinal value are extensively being used to mitigate various illnesses ever since ancient times.[1] This owes to the lesser adverse effects and better effectiveness of plants that the researchers are lately developing numerous formulations using them.[2] Based on the therapeutic effect such traditional plants are utilized to make unrefined herbal extracts or herbal formulations.[3] In this study, three medicinal plants viz., *Adoxa moschatellina*, *Alpinia galanga* and *Laurus nobilis* were used and a polyherbal formulation (PHF) was obtained. Polyherbal formulation led to discovery of various medicinal plants which were used in combination to act synergistically and produce good therapeutic effect. Thus, medicinal plants and their active constituents brought a good chance to formulate various dosage forms. This study was carried out to develop formulation and then evaluate the developed suspension for its organoleptic and physical factors which thus confirmed its safety and effectiveness.

2. MATERIALS AND METHODS

2.1 Plant Extracts

The roots of *Adoxa moschatellina*, rhizomes of *Alpinia galanga* and dried leaves of *Laurus nobilis* were finely pulverized, defatted with petroleum ether (60-80^{0}C) and then was extracted using 95% ethanol as a solvent in Soxhlet apparatus for a duration of 72 hour. After being dried under pressure, the extract yielded 199.7g (6.71%) of dark green material. The reagents and chemicals used were of analytical grades.

2.2 Development of Polyherbal Suspension

The suspensions were prepared by combining the dried alcoholic extracts of the test samples with a suitable suspending agent using trituration (Deepti et al., 2019). The determination of the necessary quantity of each extract was derived from their therapeutically efficacious dosage. Four herbal suspensions, namely AM, AG, LN, and PHF, were created. The composition of these suspensions may be seen in Table 1.

The PHF was composed of the alcoholic extracts obtained from AM, AG, and LN. The computation was derived from the amount of each dry extract needed to prepare the suspensions.

Precise measurements were taken of extracts and other substances included to make the PHF. Initially, extracts and parabens (specifically Propyl paraben at a concentration of 0.02% w/v and Methyl paraben at a concentration of 0.2% w/v) were applied to a mortar. Then, tween 80 at a concentration of 0.1% w/v and a small quantity of sodium carboxy methyl cellulose

(SCMC) at a concentration of 0.5% w/v were added and well mixed to create a homogeneous and smooth paste. Subsequently, the remaining quantity of SCMC was included to create a slurry, which was then transferred to a beaker. The beaker was washed with 100 ml of distilled water and the suspension was added. The dispersion was homogeneously mixed using mechanical agitation at a speed of 500 rpm. After achieving homogeneous mixing, the substance was then transferred to a measuring cylinder. Distilled water was then added to get the necessary amount of 100 ml.

Table 1: Composition of different formulations.

Ingredients	Formulations			
	AM	**AG**	**LN**	**PHF**
AM	1.5g	—	—	0.5014g
AG	—	1g	—	0.3343g
LN	—	—	1.5g	0.3343g
CMC sodium	0.5%,w/v	0.5%,w/v	0.5%,w/v	0.5%,w/v
Tween80	0.1%,w/v	0.1%,w/v	0.1%,w/v	0.1%,w/v
Methylparaben	0.2%,w/v	0.2%,w/v	0.2%,w/v	0.2%,w/v
Water(q.s)	100ml	100ml	100ml	100ml

AM - *Adoxa moschatellina*, *AG – Alpinia galanga*, LN - *Laurus nobilis*, PHF - Polyherbal formulation.

3. Evaluation of Polyherbal formulation

The polyherbal formulation of the drugs in study were assessed for various parameters like the organoleptic characteristics, pH, particle size, sedimentation rate, redispersibility of suspension, rheology, viscosity and crystal growth formation or stability of suspension.

3.1 Determination of Color and Odour (Organoleptic Characteristics)

Herbs are identified by their organoleptic features, which include shape, size, surface characteristics, color, texture, fracture, and fracture characteristics. It is sometimes referred to as macroscopic plant determination based on drug morphology and sensory profile analysis. This study assessed the macroscopic phenomena in AM, AG, and LN plants (WHO, 2005) which was done an hour after the formulation was prepared at 37^{o}C.[4]

Characterization of Prepared Suspensions

3.2 Determination of particle size

A stage micrometer was used to calibrate the ocular micrometer. Prior to measuring the size of the samples, the eyepiece of the stage micrometer was calibrated. The mount was prepared by applying the suspension drop onto the slide and then covering it with a coverslip. In a concise manner, the dimensions of 50 particles were determined by focussing the slide on a compound microscope in order to determine the size of the particles.[5]

3.3 Determination of pH

The pH of all the prepared suspensions was measured at room temperature using a pH meter (Bhandari et al., 2010).[6]

3.3 Determination of Sedimentation Rate

The ratio of the sediment's final height (Hu) to the suspension's initial height (Ho) was measured. In summary, the suspension was placed in a graded cylinder and left undisturbed for a certain duration. The maximum height served as an indicator of the amount of sediment (Srivastava et al., 2017).[7]

3.4 Re-dispersibility of suspension

In order to assess the re-dispersibility of the prepared PHF suspension, it was allowed to settle in a measuring cylinder and then the mouth of the cylinder was sealed.[8] The number of inversions required to reestablish a homogenous suspension was calculated.

3.5 Viscosity determination of PHF

The viscosity of the PHF suspension was measured using a Brookfield viscometer. The determination was made under ambient temperature conditions. The reading was observed 15 minutes after the equipment stabilizes.

3.6 Crystal growth formation of the suspension

The stability of the suspension was assessed at a temperature of 4°C, whereas any occurrence of crystal formation was seen at room temperature.

3.7 Stability studies conducted at an accelerated pace for polyherbal formulations

The suspensions AM, AG, LN, and PHF were held at a temperature of 50℃± 2℃ and a relative humidity of 75 ± 5% for a duration of three months. The suspensions were analyzed after 30, 60, and 90 days to assess color, odor, pH, sedimentation volume, viscosity, re-dispersibility, crystal growth and particle size.

4. RESULTS

4.1 Organoleptic properties of prepared suspensions

Organoleptic characteristics play an essential role in selecting a plant's genotype/phenotype qualities. The fresh suspensions had the following organoleptic characteristics: AM was reddish brown, AG was dark brown, LN was dark green, and PHF was dark brown. All of these formulas had a distinct smell. After 1 hour of preparation, these findings remained unchanged, retaining their nice look and unique odor even after three months of storage at 50 ± 2°C and 75 ± 5% humidity.

Table 2: Organoleptic characteristics of prepared suspensions.

S. No.	Suspensions	Odor	Color
1.	*Adoxa moschatellina* (AM),	Characteristic	Reddish brown
2.	*Alpiniagalanga (AG)*	Characteristic	Dark brown
3.	*Laurus nobilis* (LN)	Characteristic	Greenish
4.	Polyherbal formulation (PHF)	Characteristic	Dark brown

4.2 Particle size of the prepared suspensions

The particle sizes of AM, AG, LN, and PHF were 45-48, 57-60, 38-44, and 58-60, respectively. Throughout the investigation, there were no significant changes in particle size between formulations. Table 3 displays the prepared suspensions' characterization profile.

Table 3: Characterization of prepared suspensions

S. No.	Suspensions	Particle size range (µm)	pH	Sedimentation volume (ml)	Viscosity (cps)
1.	**AM**	45-48	6.65	1.18	90
2.	**AG**	57-60	6.90	1.16	187
3.	**LN**	38-44	6.76	1.17	120
4.	**PHF**	58-60	6.77	1.16	165

4.3 pH of the produced suspensions

After 1 hour of preparation, the pH of AM, AG, LN, and PHF were 6.65, 6.9, 6.76, and 6.77, respectively (Figure 1). After 90 days, the pH was 7.2 for AM, 6.45 for AG, 6.86 for LN, and 6.4 for PHF. The prepared suspensions' sedimentation volume After one hour, the sedimentation volume for AM, AG, LN, and PHF was 1.18, 1.16, 1.17, and 1.16, respectively. Figure 5.2 depicts the sedimentation volume of the prepared suspensions.

4.4 Viscosity of prepared suspensions

The viscosities of the freshly created suspensions AM, AG, LN, and PHF determined after 1 hour of preparation were 90 cps, 187 cps, 120 cps, and 165 cps, respectively (Figure 3). After three months of storage at accelerated stability study settings of 50℃ ± 2℃ and 75 ± 5% RH, the final viscosities were 114 cps, 97 cps, 131 cps, and 128.3 cps.

4.5 Re-dispersibility of Suspension

After 1 hour of preparation, all four freshly created suspensions (AM, AG, LN, and PHF) showed outstanding redispersibility. All produced a homogeneous suspension in a single inversion, implying 100% redispersibility. After three months of storage at accelerated stability study settings of 50℃ ± 2℃ and 75 ± 5% RH, AM, LN, AG, and PHF exhibited 85%, 90%, and 95% redispersibility, respectively. Crystal growth. When viewed with the naked eye and under a microscope, none of the freshly synthesized formulations AM, A G, LN, and PHF showed any signs of crystal formation. After three months of storage at 50℃ ± 2℃ and 75 ± 5% RH, no crystal formation was seen, showing the PHF's stability.

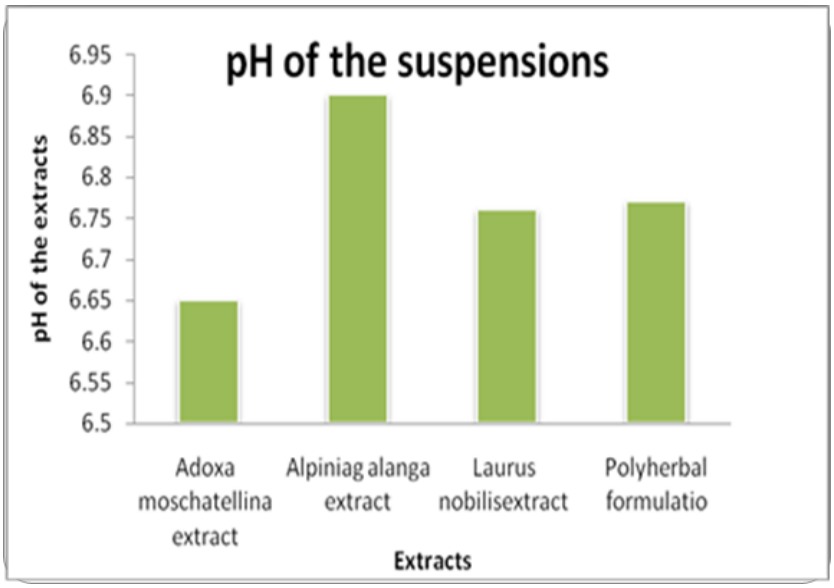

Fig 1: pH of the suspensions.

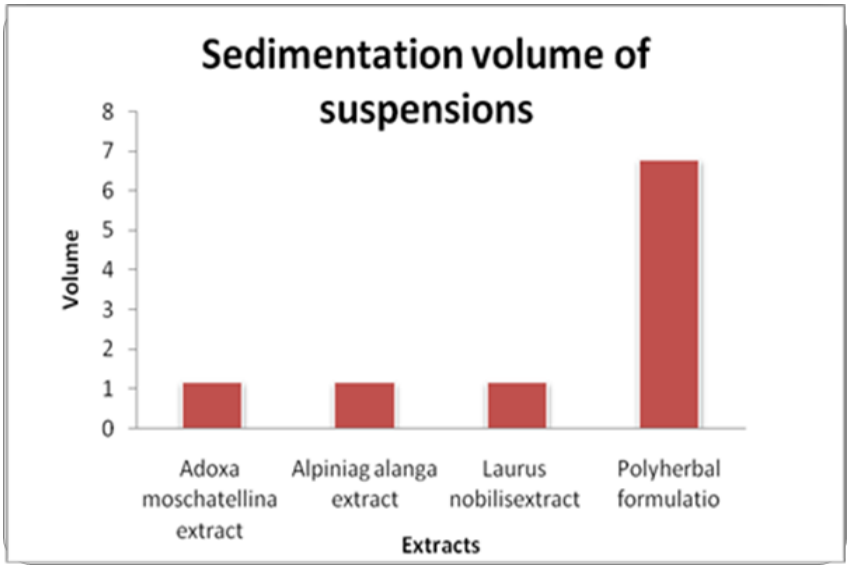

Fig 2: Sedimentation Volume of Suspensions.

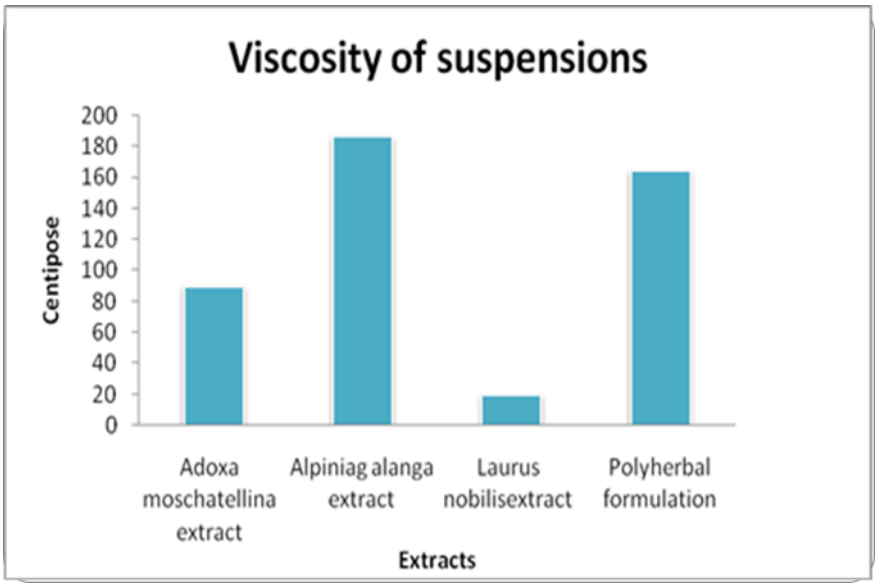

Fig 3: Viscosity of Suspension.

4.6 Stability Studies

Stability studies play a crucial role in preserving the quality, safety, and effectiveness of a product to ensure its acceptability and approval in the pharmaceutical business (Bajaj et al., 2012). The pharmaceutical evaluation and stability study data of the formulated suspensions AM, AG, LN, and PHF were analyzed after 90 days to assess their physicochemical characteristics, including color, odor, pH, sedimentation volume, viscosity, particle size, re-dispersibility percentage, crystal growth, and the number of prominent spots observed in the HPTLC pattern. The expedited examination and assessment of all formulated suspensions, namely AM, AG, LN, and PHF, after a period of 90 days may be found in Table 4.1, 4.2, 4.3, and 4.4, respectively. Figure 4 displays the pH values of the different formulations on day 90. Specifically, the pH values are 7.2, 6.45, 6.86, and 6.4 for AM, AG, LN, and PHF, respectively. Figure 5 displays the sedimentation volume of each formulation after 90 days, namely 1.26 ml for AM, 1.53 ml for AG, 1.19 ml for LN, and 1.57 ml for PHF. Figure 6 displays the viscosity of each formulation after 90 days, namely 113, 91, 129, and 87.5 cps for AM, AG, LN, and PHF, respectively. Figure 7 displays the viscosity of each formulation after 90 days, namely 90, 90, 95, and 85 centipoise for AM, AG, LN, and PHF, respectively.

Table 4.1 Pharmaceutical evaluation and stability study data of suspension AM.

Parameters	0 Day	30 Day	60 Day	90 Day
Color	Reddish Brown	Reddish Brown	Reddish Brown	Reddish Brown
Odor	Characteristic	Characteristic	Characteristic	Characteristic
pH	6.65	6.9	6.76	6.88
Sedimentation volume	1.16	1.21	1.23	1.18
Viscosity	92 cps	177 cps	110 cps	118 cps
Particle size	35-38	35-38	35-39	36-41
Redistribution (%)	100	95	95	90
Crystal growth	None	None	None	None
No. of spots Observed	9	8	7	7

Table 4.2 Pharmaceutical evaluation and stability study data of suspension AG.

Parameters	0 Day	30 Day	60 Day	90 Day
Color	Dark brown	Dark brown	Dark brown	Dark brown
Odor	Characteristic	Characteristic	Characteristic	Characteristic
pH	6.78	6.66	6.5	6.65
Sedimentation Volume	1.12	1.47	1.50	1.33
Viscosity	100 cps	96.7 cps	98.0 cps	99.0 cps
Particle size	56-59	56-59	60-63	59-63
Redistribution (%)	100	95	90	90
Crystal growth	None	None	None	None
No. of spots Observed	8	7	7	7

Table 4.3 Pharmaceutical evaluation and stability study data of suspension LN.

Parameters	0 Day	30 Day	60 Day	90 Day
Color	Dark green	Dark green	Dark green	Dark green
Odor	Characteristic	Characteristic	Characteristic	Characteristic
pH	6.66	6.66	6.65	6.15
Sedimentation Volume	1.15	1.15	1.19	1.29
Viscosity	106 cps	112 cps	119 cps	121 cps
Particle size	39-45	40-43	41-43	41-43
Redistribution (%)	100	95	95	95
Crystal growth	None	None	None	None
No. of spots Observed	9	9	9	9

Table 4.4 Pharmaceutical evaluation and stability study data of suspension PHF.

Parameters	0 Day	30 Day	60 Day	90 Day
Color	Light brown	Light brown	Light brown	Light brown
Odor	Characteristic	Characteristic	Characteristic	Characteristic
pH	6.68	6.71	6.75	6.32
Sedimentation Volume	1.11	1.44	1.53	1.17
Viscosity	148 cps	96.2 cps	88.9 cps	127.5 cps
Particle size	49-55	50-53	51-53	51-53
Redistribution (%)	100	90	85	85
Crystal growth	None	None	None	None
No. of spots Observed	7	6	6	5

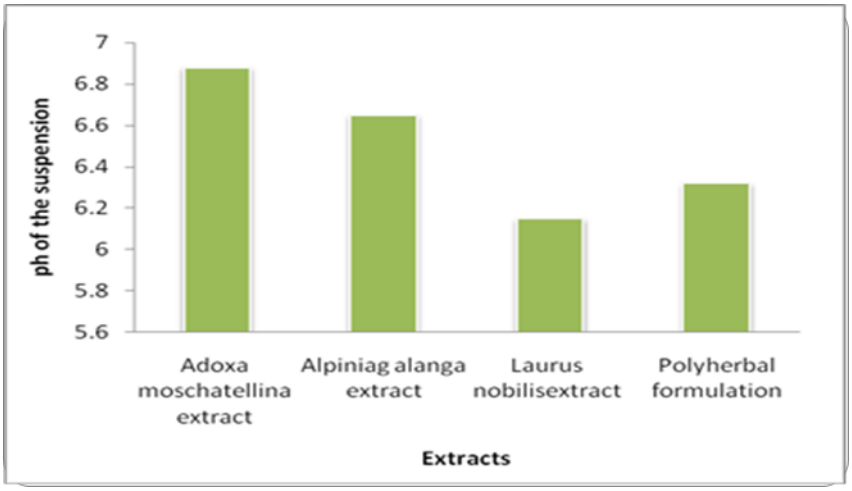

Fig 4: pH of the prepared suspension after 90 days of storage.

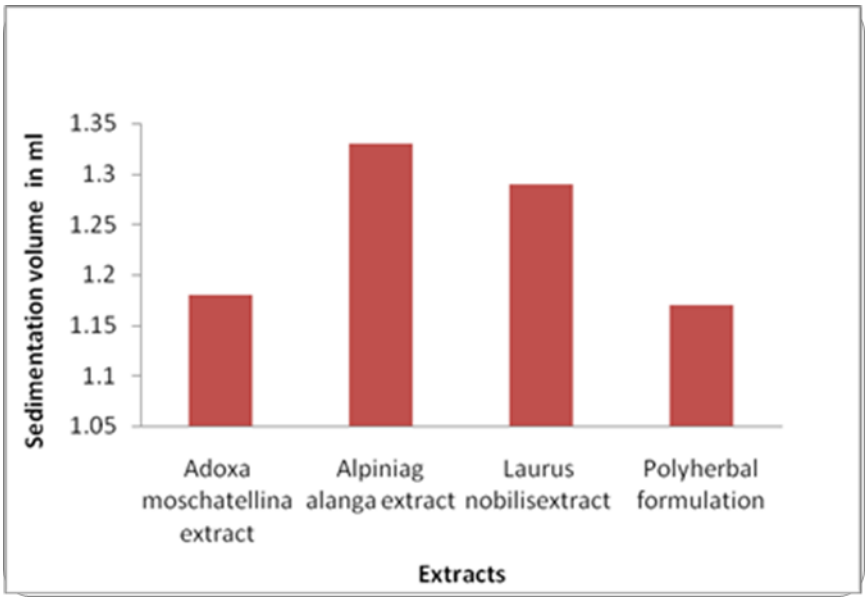

Fig 5: Sedimentation volume of the prepared suspension after 90 days of storage.

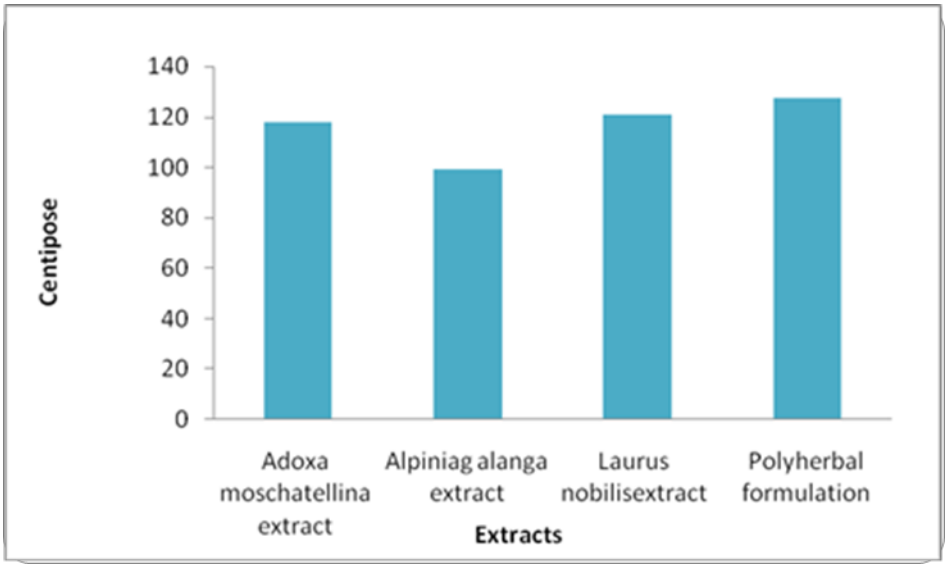

Fig 6: Viscosity of prepared suspension after 90 days of storage.

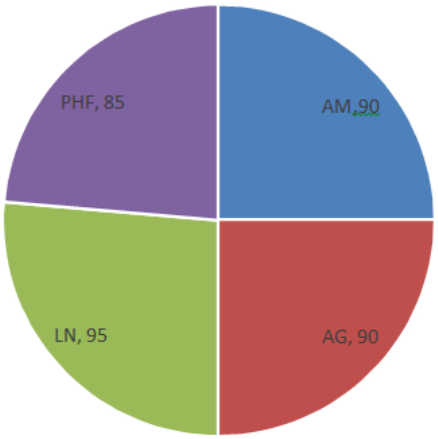

Fig 7: Redistribution of prepared suspension after 90 days of storage.

5. CONCLUSION

The polyherbal suspension consisting of the extracts of *Adoxa moschatellina*, *Alipinia galanga* and *Laurus nobilis* was prepared using Sodium CMC as thickening agent. The formulated suspension was confirmed to be satisfactory in terms of odour, colour, taste indicating it to be good and safe for use. The viscosity range of formulations was found to be between 87.5-129 cps which depicts that the suspension is easy to pour. The pH value was found to be 7.2, 6.45,6.86 and 6.4 for AM, AG, LN and PHF respectively while the sedimentation value was 1.26ml for AM, 1.53 for AG, 1.19 ml for LN and 1.57 for PHF. Thus, the present study developed polyherbal formulation successfully and evaluated all the parameters necessary which makes it acceptable for therapeutic use in patients.

6. ACKNOWLEDGEMENT

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7. Conflicts of Interest

Nil.

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