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Formulation Development and Evaluation of Nanoemulsion of Hippaestrum vittatum (Lily) flowers extract

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ABSTRACT

Due to their capacity for regulated distribution and optimal dispersion of active substances into the targeted layers of skin, cosmeceutical nanoemulsions for skin care are in higher demand. The current study was based on the formulation development and evaluation of nanoemulsion of Hippaestrum vittatum. The flowers of H. vittatum were collected from the Unnao region, Uttar Pradesh. These were identified and authenticated by a botanist. These were washed, dried under shade and sieved for making dust-free and kept at room temperature. The powder of Hippaestrum vittatum were weighed and extracted through maceration using ethyl alcohol. The flowers of Hippaestrum vittatum were soaked into a beaker containing ethyl alcohol solvent for 15 days with frequent stirrings. The beaker was mounted with aluminium foil. Preliminary phytochemical screening was done for the herbal extract. After preformulation study, nanoemulsion was prepared using spontaneous emulsification method and characterized for parameters i.e., physical appearance, physical appearance, droplet size, polydispersity index (PDI), % drug content, viscosity, pH, in-vitro drug release and stability. In results, the H. vittatum flowers were extracted through cold maceration process using ethyl alcohol and percentage yield was found to be 11.29 %. Herbal extract showed the maximum absorption wavelength (λmax) at 290nm when determined in the conc. range of 2 µg/ml to 12 µg/ml. The maximum in-vitro drug release was observed in F3 formulation i.e., 95.26±0.4 (12 hours). After 1 month, the % drug content, pH and in-vitro drug release were re-checked and found significant unchanged. It concluded that the nanoemulsion development of H. vittatum flowers extract enhanced the solubility with the utilization of surfactant Pluronic F127. The minimum droplet size and larger surface area improved the solubility and dispersion of the active bioactive molecules. In suggests, the researchers to determine the mode of action for diverse pharmacological properties thus H. vittatum flowers extract-based nanoemulsion can be utilized in management of various diseases.…

Keywords: Lily, nanoemulsion, spontaneous emulsification method, drug release...

INTRODUCTION

Due to their capacity for regulated distribution and optimal dispersion of active substances into the targeted layers of skin, cosmeceutical nanoemulsions for skin care are in higher demand. The active components are more suited for numerous activities when they are present as nanoparticles because they have a higher surface-to-volume ratio that encourages dispersibility in the emulsion [1]. The morphology of nanoemulsions can be used to categorize them. An oil-based or water-in-oil (W/O) emulsion results from the inverse of the situation, which has water as the continuous phase and oil as the dispersed phase [2]. The homogeneous deposition and penetration of active substances through the skin's surface are made possible by the nanoemulsion's small droplet size. Due to the enormous surface area and low surface tension of the entire emulsion system in nanoemulsions the contents penetrate components more effectively, requiring just 3–10% of surfactants during preparation [3].

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Hippeastrum is a genus of plants that includes a lot of alkaloids and is becoming more popular as a treatment for neurological illnesses and neurodegenerative diseases [4]. It is made up of more than 70 species that are found in South America's tropical and subtropical regions [5]. Hippeastrum plants came in a variety of hybrids, and most present commercial hybrids are descended from Hippeastrum vittatum Herb [6].

Leaves **b. Leaves**

Fig 1. *Hippeastrum vittatum* herb

Taxonomy

Kingdom : Plantae

Class : Magnoliopsida

Order : Asparagales

Family : Amaryllidaceae

Genus : *Hippeastrum*

Species : *vittatum*

Hippeastrum vittatum is native to Central & South America, Brazil, and Peru, and is currently the world's most frequently cultivated Amaryllis, which originated in South Africa in the Cape of Good Hope in 1633 and was imported to Europe [7]. The ethanolic fresh flower extract from *Hippeastrum vittatum* revealed the unique alkaloids, tannins, glycosides, including Ismine, Lycorine. Crinine, Vittacarboline, Haemanthamine, Narciclasine, Galanthamine, Tazettine [8].

Hippeastrum vittatum possesses anticancer, antiviral, anti-inflammatory, and other pharmaceutical properties. Malignant tumours have emerged as one of the most serious risks to human health and mortality [9][10].

MATERIALS AND METHODS

Experimental requirements

Flowers of *Hippaestrum vittatum*, PF127 (Sigma Aldrich, India), ethanol, DMSO, KBr, phosphate buffer and distilled water.

Collection, Identification & Authentication of plant

The flowers of *Hippaestrum vittatum* were collected from the Unnao region, Uttar Pradesh. These were identified and authenticated by a botanist. These were washed, dried under shade and sieved for making dust-free and kept at room temperature.

Extraction of plant

The powder of *Hippaestrum vittatum* were weighed and extracted through maceration using ethyl alcohol. The flowers of *Hippaestrum vittatum* were soaked into a beaker containing ethyl alcohol solvent for 15 days with frequent stirrings. The beaker was mounted with aluminium foil. At last, it was filtered with whatman filter paper thus obtained the herbal extract in a homogenous manner. A rotating evaporator was used to dry the brownish, semisolid extract obtained under partial vacuum. The % yield of the extract was calculated [11].

Preliminary phytochemical screening [12][13].

Detection of Alkaloids

Extracts are dissolved individually in dilute HCl and filtered.

Mayer's Test: Filtrates are treated with Mayer's reagent (Potassium Mercuric Iodide). Formation of a yellow-colored precipitate indicates the presence of alkaloids.

Wagner's Test: Filtrates are treated with Wagner's reagent (Iodine in Potassium Iodide). Formation of brown/reddish precipitate indicates the presence of alkaloids.

Hager's Test: Filtrates are treated with Hager's Reagent. Formation of yellow ppt indicates the presence of alkaloids.

Detection of Glycosides

Fehling's test: With distilled water dilution, Fehling's solutions A and B are heated for one minute. There were 8 drops of plant extract added to this transparent blue solution. It is then combined with 1 ml of Fehling's solution and heated for 5 minutes in a water bath. Brick red precipitation is an indication of glycoside content.

Detection of Saponins

Foam test: About 2g of the plant extract was mixed with 10ml of distilled water and shaken vigorously for a stable persistent froth. Appearance of froth indicates the presence of saponins.

Detection of Tannins

Ferric chloride test: 0.5g of the dried powdered sample is boiled in 20ml of water in a test tube and then filtered. A few drops of 0.1% $FeCl_3$ is added and observed for brownish green-black or a blue-black coloration.

Lead acetate test: 2ml of plant extract is combined with 2ml of distilled water. 0.01g lead acetate is added to this combined solution and shaken well. Development of white turbidity and precipitate indicates the presence of tannins.

Detection of Flavonoids

NaOH test: A small amount of extract is treated with aqueous NaOH and HCl, and observed for the formation of yellow orange color.

H_2SO_4 test: A fraction of the extract is treated with Conc.H_2SO_4 and observed for the formation of orange color.

Detection of terpenoids

5 ml of the aqueous plant extract is combined with 2.0 ml of chloroform, which is then added, evaporated on the water path, and boiled with 3 ml of concentrated H2SO4. As terpenoids took shape, a grey colour emerged.

Detection of Steroids

2 ml of chloroform and concentrated H_2SO_4 are added with the 5 ml aqueous plant crude extract. In the lower chloroform layer red color appeared that indicates the presence of steroids.

Test for Reducing Sugars and Carbohydrates

Molisch test

To 2-3ml extract of individual solvents add few drops of α-naphthol solution in alcohol, shake and add concentrate H_2SO_4 from sides of test tube. Violet ring at the junction of two liquids.

Fehling's test

It is used to determine decreasing sugars. 34.66 grams of copper sulphate should be dissolved in 500 millilitres of distilled water (solution A). Distilled water should be used to dissolve 50 grams of sodium hydroxide and 17.3 grams of potassium sodium tartrate to a maximum volume of 50 millilitres (Solution B). Mix two solutions in the same volume before using. Boil a 1 mL combination of Fehling's A and B solution for one minute. Equal amounts of the test solution should be added. Heat for five to ten minutes in a kettle of boiling water. The colour changed from yellow to brick red.

Pre-formulation study

Organoleptic properties

The obtained flowers extract of *H. vittatum* was observed for its physical characteristics i.e., colour, odour, and texture of herbal extract.

Solubility

The solubility of flowers extract of *H. vittatum* was determined by placing a small quantity of polymers individually in a test tube, adding 5ml of solvent (water, ethanol, methanol, phosphate buffer), shaking vigorously, and holding for a while. Take note of the product's solubility in various solvents when it is at room temperature.

Extract-excipients compatibility studies

Compatibility of herbal extract with different polymers used in the preparation of formulation was determined through FTIR spectroscopy. The herbal extract was mixed with potassium bromide and pressed into the shape of a disc. The disc was examined using Shimadzu FTIR spectroscopy (4000-400cm^{-1}).

Preparation of standard calibration curve

100mg of flowers extract of *H. vittatum* was accurately weighed and dissolved in methanol (2ml) and volume was made up to 100ml with 0.1N HCl solution thus stock solution prepared. The 10ml of stock solution was further diluted with 0.1N HCl (pH 1.2) in 100ml to get mixture of 100µg/ml. Then 0.2, 0.4, 0.6, 0.8, and 1ml of solution was taken into 10ml standard volumetric flask and made the volume up to 10 ml with 0.1N HCl to prepare 2µg/ml, 4µg/ml, 6µg/ml, 8µg/ml, and 10µg/ml solution. Then the absorbance was measured in a UV spectrophotometer at 270nm against 0.1N HCl as blank. The procedure was repeated with phosphate buffer at pH 6.8 and absorbance was measured at wavelength 270nm [14].

Preparation of formulation (Spontaneous emulsification method)

The essential oil included dissolved *Hippaestrum vittatum,* Surfactant PF127 and preservative methyl paraben were dissolved in water to prepare the aqueous phase. In order to avoid heating the system, nanoemulsion was made by gradually integrating the oil phase into the aqueous phase using an ultrasonic processor. The temperature was kept as 15±8°C. The formulation was prepared and stored at 25°C/ room temperature. In order to assess the stability of the dispersion, we changed the ratios of peppermint essential oil from 5% to 10% and the quantity of surfactant in the aqueous phase from 5% to 15% [15].

Table 1. Formulation composition (Oil phase)

Formulation	**Oil phase**	
	Herbal extract (%)	**Peppermint oil (%)**
F 1	5.0	35
F 2	5.0	40
F 3	5.0	35
F 4	5.0	35
F 5	5.0	35
F 6	5.0	40

Table 2. Formulation composition (Aqueous phase)

Formulation	**PF127 (surfactant)**			**Methyl paraben (%)**	**Distilled water (%)**
	5 %	***10 %***	***15 %***		
F 1	5.0	_	_	0.1	55
F 2	_	_	5.0	0.1	50
F 3	10.0	_	_	0.1	50
F 4	_	10.0	_	0.1	50
F 5	_	_	10.0	0.1	50
F 6	_	_	5.0	0.1	50

Characterization parameters [16][17][18][19]

Physical appearance

Total 6 forms of Nanoemulsion were developed including F1-F6 and estimated for their physical appearance i.e., transparency, homogenous/heterogenous, white or turbidity. Homogenous nanoemulsion represents the better formulation process of nanoemulsion.

Droplet size and Polydispersity index (PDI)

Zetasizer Nano-ZS was used to measure the average globule size of the nanoemulsion (Malvern Instrument, UK). The measurements are taken at a 90˚ angle at 25ºC. To make sure the light scattering intensity was within the instrument sensitivity range, twice distilled water was used to dilute the nanoemulsion. All measurements are made at 25ºC. The same instrument was used to calculate the formulation's polydispersity index. The polydispersity index reveals the width of the size distribution.

***In vitro* drug release**

In PBS solution (pH 7.4), a small amount of the nanoemulsion was dissolved into it. The residual volume was then brought up to 100 ml with PBS after the solvent ethanol was added to make the polymer soluble (pH 7.4). After then, 1 ml was taken out of the solution and diluted once more up to 10 ml. At a wavelength of 270 nm, the solution's absorbance was measured, and concentration was determined.

A modified Franz diffusion cell was used to conduct in vitro diffusion. As a diffusion cell, a glass cylinder of 10 cm in height, 3.7 cm in outer diameter, and 3.1 cm in inner diameter was employed. To create a diffusion cell, a sheep mucosa was attached to one end of the cylinder via an. A cell was given 1 ml of the nanoemulsion, and the cell was then placed in the receptor compartment of a beaker containing 100ml of pH 6.8 phosphate buffer. The receptor compartment was in touch with the whole surface of the cell, and a temperature of 37ºC was maintained while the receptor compartment was being churned magnetically. To keep the sink condition, 10ml of the receptor compartment samples wwa extracted and refilled with the same volume.

% Drug content

In a 10ml volumetric flask, a specific amount of the formulation was taken and diluted with ethanol. The absorbance of the resulting solution was sonicated for three minutes at room temperature, and its absorbance was measured at a maximum of 240 nm against a blank.

Viscosity

At room temperature, the viscosity of a nanoemulsion was determined using a Brookfield viscometer. Three separate tests were carried out using two spindle speeds to measure viscosity.

pH

Calculating pH was a crucial component of the nanoemulsion evaluation process. The pH of the finished preparation, and route of administration were determined by the excipients employed in the formulation. A digital pH metre was used to determine the formulation's pH. To decrease mistake, the findings were taken in three copies.

Stability

The stability of the nanoemulsion was investigated at 37°C for a month, respectively. Transparency was assessed in the sample. Every month for three months, check the % drug content, pH and in-vitro drug release.

RESULTS AND DISCUSSION

Percentage yield

The *H. vittatum* flowers were extracted through cold maceration process using ethyl alcohol and percentage yield was found to be 11.29 %.

Preliminary phytochemical screening

H. vittatum extract reported the alkaloids, carbohydrates, flavonoids, terpenoids and protein in abundance. However, saponins and amino acids were found in moderate amount in flowers extract of *H. vittatum***.** Tannins and glycosides were found absent.

Table 3. Phytochemical screening of *H. vittatum*

Phytochemicals	***H. vittatum* flower extract**
Alkaloids	++
Carbohydrates	++
Saponins	+
Tannins	_
Terpenoids	++
Glycoside	_
Flavonoid	++
Amino acids	+
Proteins	++

Where (+)= Moderate, (++)= Abundance, (-)=Negative

Pre-formulation studies

Organoleptic properties

Table 4. Organoleptic properties of *H. vittatum* extract and excipients

Ingredients	**Organoleptic characteristics**		
	Appearance	**Colour**	**Odor**
H. vittatum	Solid Powder	Greenish-brown	Characteristics
Peppermint oil	Liquid	Pale yellow	Mint
Pluronic F127	Solid powder	Colorless	Odorless
Methyl paraben	Crystalline powder	White	Odorless

Solubility

The solubility of *H. vittatum* extract in the different solvents was assessed. *H. vittatum* extract demonstrated the solubility in ethanol and chloroform. It was found insoluble in water.

Table 5. Solubility of *H. vittatum* extract

Solvent	***H. vittatum* extract**
Ethanol	Soluble
Distilled water	Insoluble

Chloroform	Soluble
Phosphate Buffer Solution (pH 7.4)	Highly soluble

Herbal extract-excipients compatibility studies

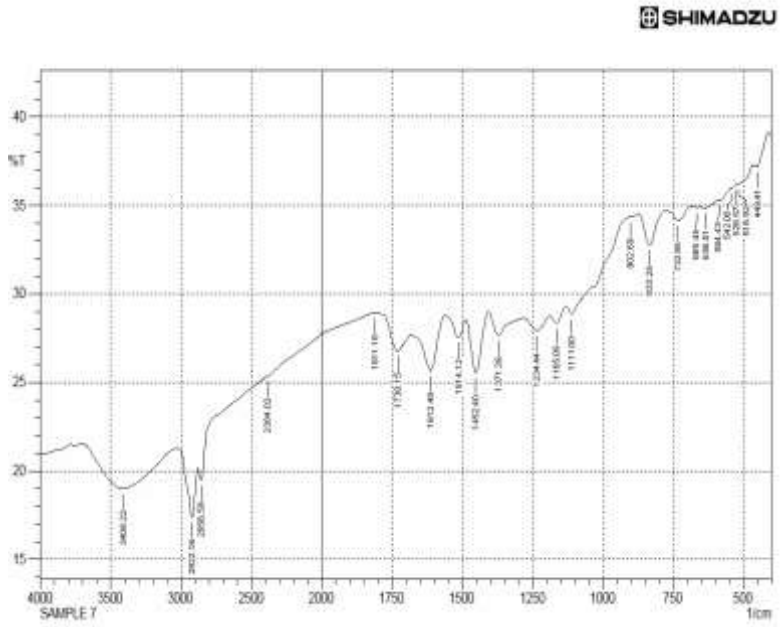


Fig 2. IR spectrum of *H. vittatum* extract

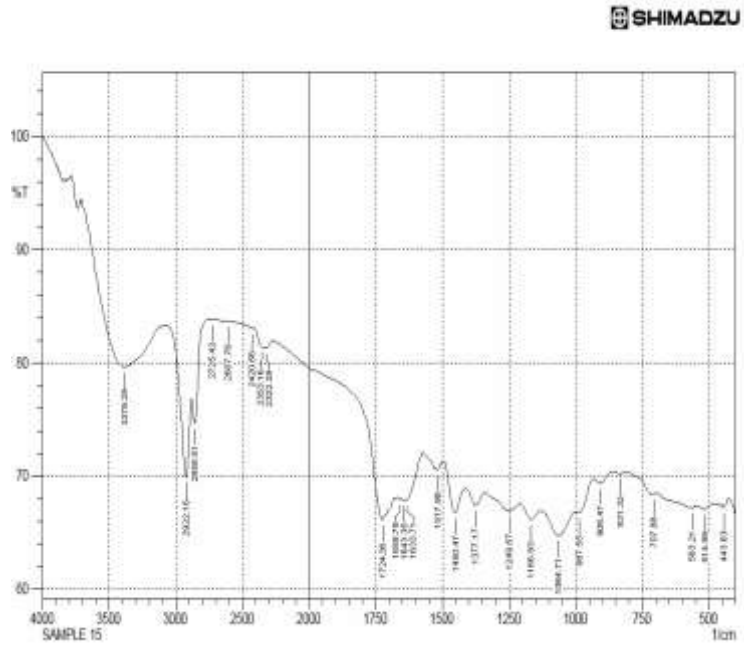


Fig 3. IR spectrum of Peppermint oil

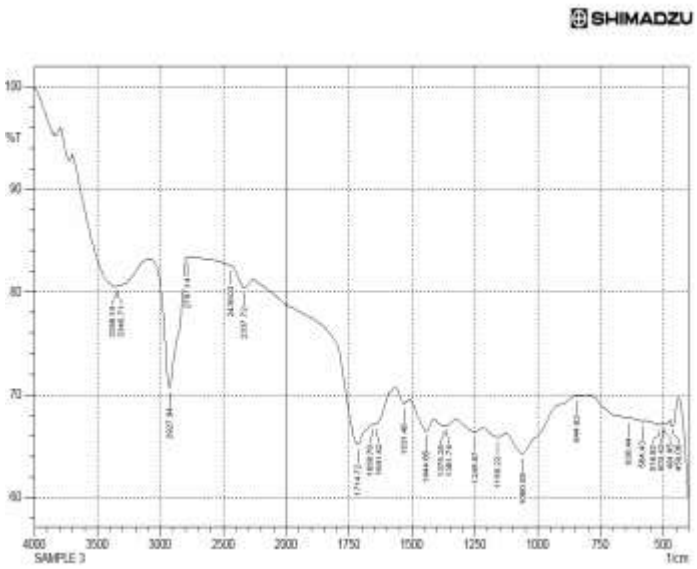


Fig 4. IR Spectrum of Pluronic F127

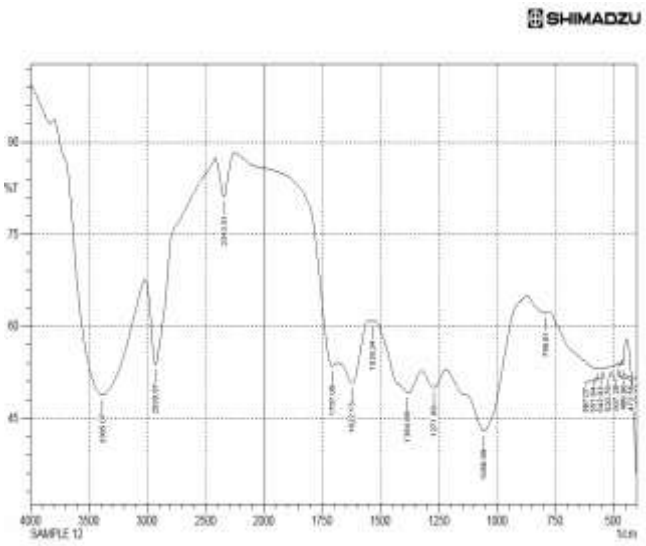


Fig 5. IR spectrum of Methyl paraben

Preparation of Std. Calibration curve

Herbal extract showed the maximum absorption wavelength (λmax) at 290nm when determined in the conc. range of 2 µg/ml to 12 µg/ml.

Table 6. Std. Calibration curve of *H. vittatum* extract

Conc. (µg/ml)	Absorption (λmax 290 nm)
2	0.16
4	0.31
6	0.46
8	0.63

10	0.78
12	0.95

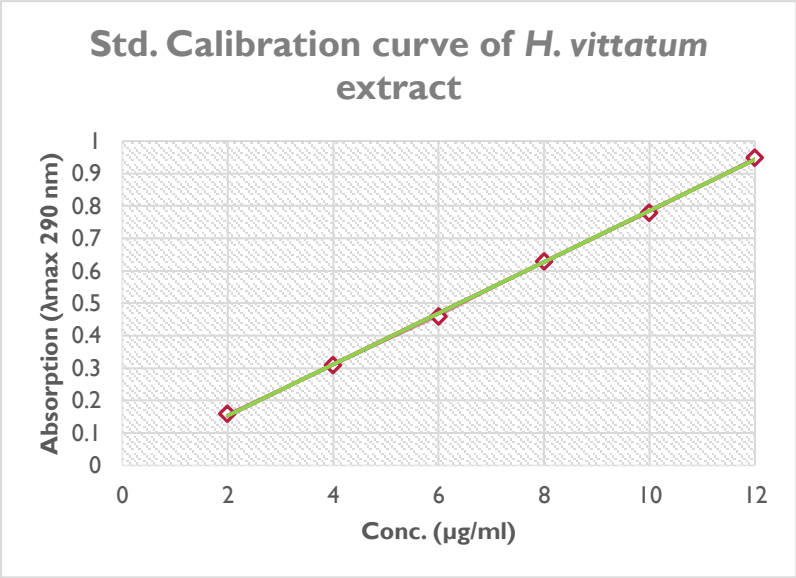


Fig 6. Std. Calibration curve of *H. vittatum* extract

Characterization parameters

Physical appearance

In order to characterize total 6 formulations of nanoemulsion, F1- F6 were evaluated for their physical appearance i.e., Colour, homogenous/heterogenous. It showed that medicated formulations were homogenous with pale yellow in appearance.

Table 7. Physical appearance of H. vittatum-based nanoemulsion

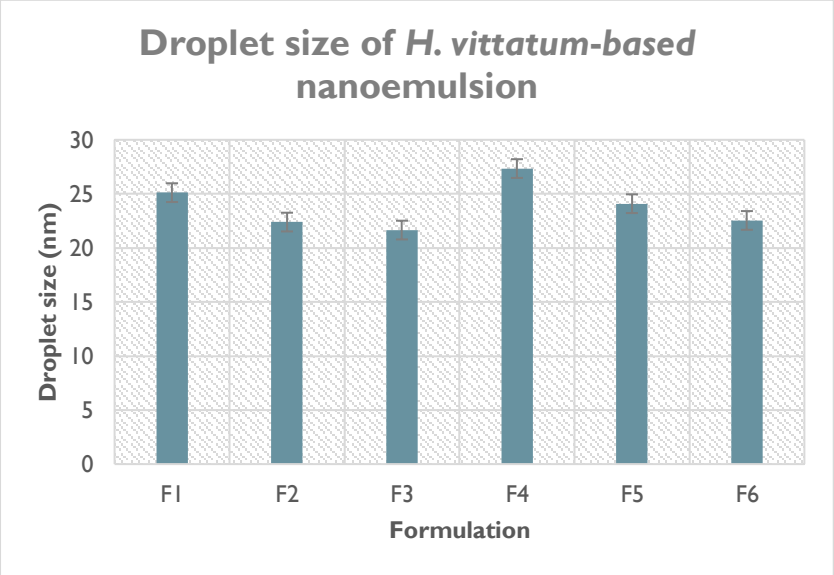
Formulation	Physical appearance
F 1	Pale yellow, homogenous
F 2	Pale yellow, homogenous
F 3	Pale yellow, homogenous
F 4	Pale yellow, homogenous
F 5	Pale yellow, homogenous
F 6	Pale yellow, homogenous

Droplet size analysis

It showed that identical droplet size represents an enhanced bioavailability. Droplet size was observed in the range of 21.65±0.21 nm to 27.34±0.29 nm.

Table 8. Droplet size of *H. vittatum-based* nanoemulsion

Formulation	Droplet size (nm)
F1	25.11±0.42
F2	22.39±0.10
F3	21.65±0.21
F4	27.34±0.29
F5	24.09±0.35
F6	22.54±0.14

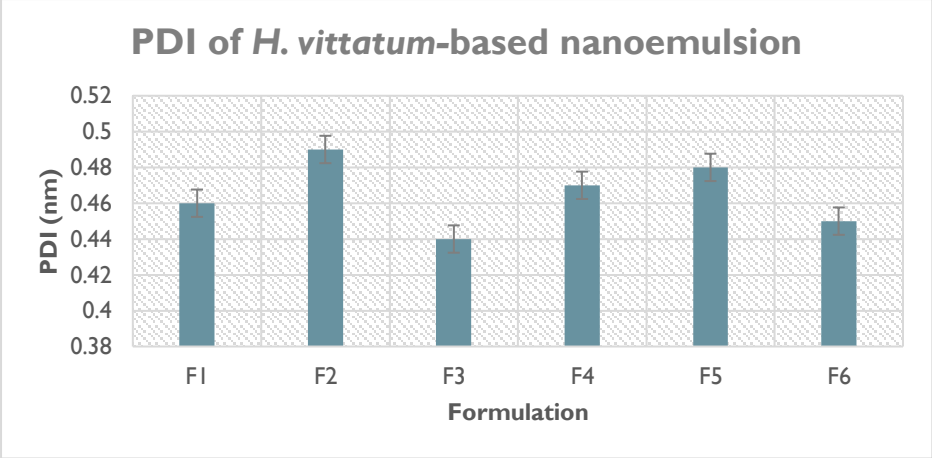


Analysis of PDI

The most significant PDI was estimated in F3 as 0.44±0.17 nm. However, highest PDI was found as 0.48±0.26 nm in F5.

Table 9. PDI of H. vittatum-based nanoemulsion

Formulation	PDI
F1	0.46±0.12
F2	0.49±0.23
F3	0.44±0.17
F4	0.47±0.12
F5	0.48±0.26
F6	0.45±0.20



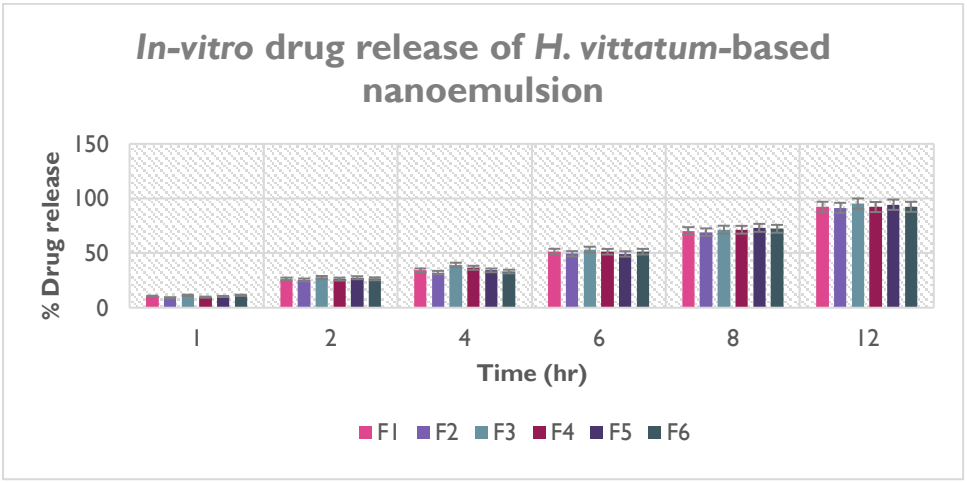
***In-vitro* drug release**

The maximum *in-vitro* drug release was observed in F3 formulation i.e., 95.26±0.4 (12 hours).

After 12 hours, drug release was estimated as 92.34±0.2, 91.43±0.1, 92.14±0.3, 94.27±0.1 and 92.31±0.3 in F1, F2, F4, F5 and F6, respectively.

Table 10. In-vitro drug release of H. vittatum-based nanoemulsion

Time (hr)	% Drug release ± S.D.					
	F1	F2	F3	F4	F5	F6
0	0.00	0.00	0.00	0	0.00	0
1	10.43±0.4	9.14±0.2	11.34±0.6	9.63±0.4	10.27±0.6	11.34±0.2
2	26.20±0.2	25.45±0.6	27.63±0.4	26.16±0.2	27.45±0.1	26.45±0.4
4	34.21±0.4	32.12±0.1	39.21±0.3	36.51±0.4	34.13±0.3	33.11±0.1
6	51.34±0.1	49.31±0.3	53.15±0.4	51.23±0.2	49.29±0.4	51.27±0.4
8	70.19±0.3	69.14±0.6	71.45±0.1	71.34±0.4	73.10±0.6	72.21±0.6
12	92.34±0.2	91.43±0.1	95.26±0.4	92.14±0.3	94.27±0.1	92.31±0.3



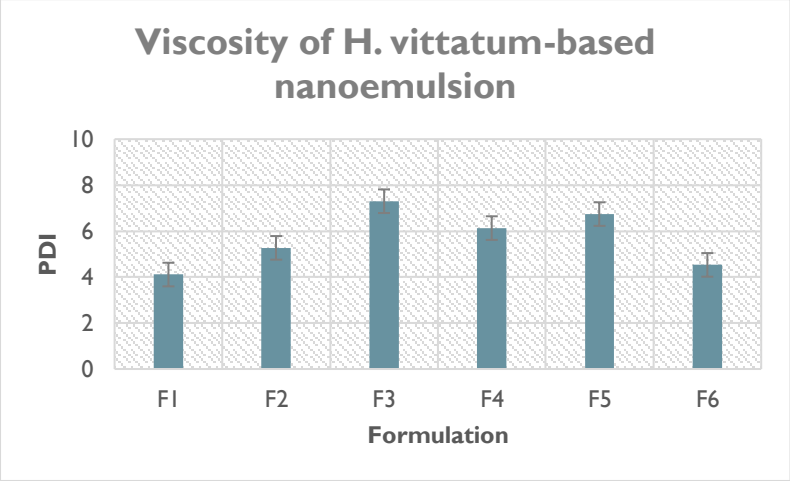
Determination of viscosity

Optimized viscosity facilitates the absorption and thus enhances the bioavailability of nanoemulsion. The formulation F3

demonstrated the increased viscosity as 7.39±0.03 cP. While F1, F2, F4, F5 and F6 showed the viscosity as 4.11±0.04 Cp, 5.27±0.02 cP, 6.13±0.07 cP, 6.74±0.05 cP and 4.53±0.06 cP, respectively.

Table 11. Viscosity of H. vittatum-based nanoemulsion

Formulation	Viscosity (cP)
F1	4.11±0.04
F2	5.27±0.02
F3	7.39±0.03
F4	6.13±0.07
F5	6.74±0.05
F6	4.53±0.06

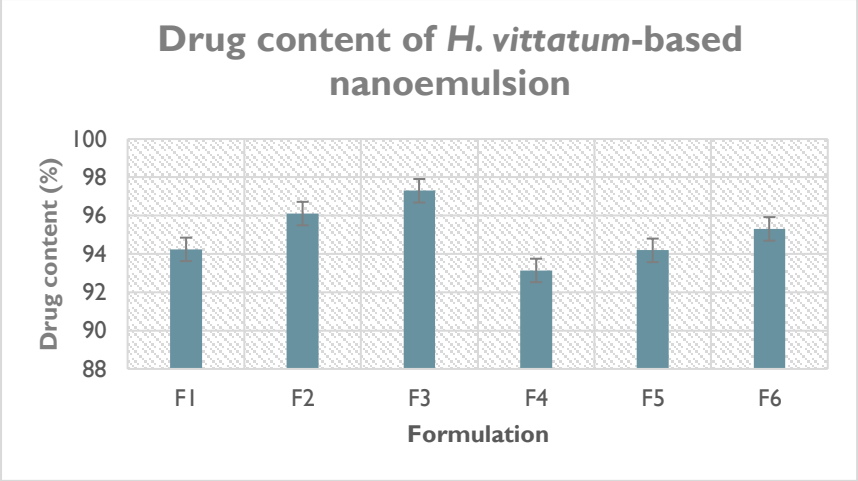


Drug content

It exhibits the reliable and almost identical drug content in different formulations of nanoemulsion. Drug content (%) was estimated as 93.14± 0.27 % to 97.30± 0.19 %. The highest drug content was observed as 97.30± 0.19 (F3).

Table 12. Drug content of *H. vittatum*-based nanoemulsion

Formulation	Drug content (%)
F1	94.24± 0.12
F2	96.11± 0.16
F3	97.30± 0.19
F4	93.14± 0.27
F5	94.19± 0.26
F6	95.31± 0.11

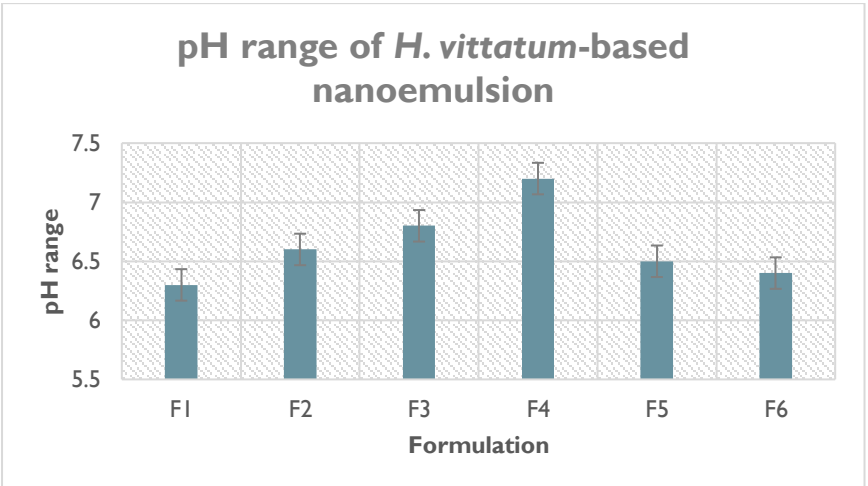


pH measurement

The pH of herbal based nanoemulsion was found slightly acidic or basic. Post 1 hour preparation, the pH was estimated. It assures that the pH range used to prepare the nanoemulsion was ideal for their better patients' compliance.

Table 13. pH range of *H. vittatum*-based nanoemulsion

Formulation	pH range
F1	6.3± 0.21
F2	6.6± 0.29
F3	6.8± 0.16
F4	7.2± 0.18
F5	6.5± 0.27
F6	6.4± 0.31



Stability studies

The stability of the nanoemulsion was investigated at 37°C for a month, respectively. Transparency was assessed in the sample. After 1 month, the % drug content, pH and *in-vitro* drug release were re-checked and found significant unchanged. Thus, it showed that *H. vittatum*-based nanoemulsion is significantly stable formulation which has a long shelf life and can be stored for longer time prior uses at standard storage conditions.

One significant advantage of nanoemulsion is their protection of bioactive from degradation by heat, light, and oxygen, reducing photodegradation and oxidation. This protective effect extends shelf life and enhances stability by minimizing environmental damage. Nanoemulsion also improves bioavailability by promoting better absorption through the digestive tract. Their small droplet size enhances solubility and interaction with cell membranes, allowing more bioactive compounds to reach systemic circulation. Potential applications include cosmetics and pharmaceuticals, where T. chebula extracts in nanoemulsion could provide anti-oxidant and anti-aging benefits. In functional foods and beverages, nanoemulsion can increase the bioavailability of therapeutic compounds, improving the effectiveness of supplements and functional foods. Several mechanisms improve the absorption of *T. chebula* bioactive compounds when formulated as nanoemulsion, addressing challenges like low aqueous solubility and poor bioavailability, especially with compounds such as chebulagic acid, chebulinic acid, and gallic acid. A key factor is the increased surface area provided by nanoemulsion's small droplet size, which enhances the dissolution of bioactive matter and increases its contact with absorption surfaces. Encapsulation of hydrophobic bioactive in nano-sized oil droplets further boosts their solubility, leading to better absorption. Surfactants and lipid carriers in nanoemulsion improve permeability, facilitating better passage of bioactive compounds across biological membranes. Nanoemulsion also promotes lymphatic absorption, bypassing first-pass liver metabolism, thereby reducing degradation and increasing systemic availability of bioactive. In addition, nanoemulsion often possess mucoadhesive properties, which prolong retention in the gut, giving more time for absorption. They also protect bioactive compounds from degradation in the GI tract, preserving their integrity. Facilitated endocytosis allows nano-sized particles to be directly absorbed by cells, further enhancing bioavailability [20].

Nano-sized globules further enhanced dissolution and release characteristics by increasing the surface area available for drug diffusion. The optimized nanoemulgel formulation remained physically stable under various storage settings, according to the stability studies, with no appreciable changes in droplet size, pH, appearance, or phase separation. Enhanced skin permeation observed in nanoemulgel systems can be explained by several mechanisms. The nanosized droplets provide close contact with the skin surface and improve penetration through the stratum corneum. Surfactants present in the formulation disrupt the lipid arrangement of the skin barrier and increase permeability of active constituents. In addition, the gel system prolongs residence time of the prepared formulation at the site of application, thereby improving retention and localized delivery of the herbal extract. Overall, the developed *Swietenia macrophylla* nanoemulgel demonstrated promising physicochemical characteristics, good stability, controlled drug release, and suitability for topical drug delivery. The nanoemulgel system may therefore serve as an effective platform for delivery of herbal bioactive compounds in topical therapeutic applications [21].

The preparation and evaluation of the nanoemulgel loaded with neem and turmeric extract for the topical delivery of drugs against microbial infection marks the conclusion of this investigation. According to reports, because of their target selectivity, non-toxicity, biocompatibility, and biodegradability, nanoemulsions are a promising choice for antimicrobial nanosystems. The improved nanoemulsion in this work was successfully blended with the gel foundation to develop a topical nanoemulgel formulation. The properties of the nanoemulgel loaded with neem and turmeric extract were successfully assessed to determine whether it was suitable for topical application [22].

The solubility of *Glycyrrhiza glabra* was determined indifferent oils. It was evident that *Glycyrrhiza glabra* exhibited highest solubility in isopropyl myristate (195.71±0.91 mg^2/ml) as polarity of the poorly soluble drugs favors their solubilization in small/medium molar volume oils. Edible oils cannot depict large micro emulsion region due to their rancid nature. IPM was selected for the preparation of nanoemulsion due to its well-known permeation enhancing property and biocompatibility. The most critical problem related in the development of nanoemulsion based drug delivery systems is the toxicity of the surfactants. Large amounts of surfactants may cause skin irritation when administered transdermally. It is therefore important to determine the surfactant concentration properly and use the minimum concentration in the development of nanoemulsion formulation [23].

In order to select suitable oils and surfactants for good solubilizing of herbal extract of *Glycyrrhiza glabra* in various oil and surfactant were determined. Medium and long chain triglyceride oils with different degree of saturation have been tried in the development of nanoemulsion. Amongst various surfactants screened, Tween 80 exhibited (96.8±1.47 mg^2/ml) highest solubilization capacity of GGE Surfactant chosen must be able to lower the interfacial tension to a very small value to aid the dispersion process during the preparation of the nanoemulsion, provide a flexible film that can readily deform around droplets. aqueous phase, the second representing oil and the third representing a mixture of surfactant and co surfactant at a fixed mass ratio [24].

CONCLUSION

It concluded that the nanoemulsion development of *H. vittatum* flowers extract enhanced the solubility with the utilization of surfactant Pluronic F127. The minimum droplet size and larger surface area improved the solubility and dispersion of the active bioactive molecules. Among all the formulations, F3 showed excellent drug release, drug content and physical appearances when observed. Furthermore, nanoemulsion was found stable, thus prevented the deterioration of active moieties and produced a more significant therapeutic outcome. The improved bioavailability is anticipated to enhance the various

therapeutic activities of *H. vittatum* flowers extract.

In suggests, the researchers to determine the mode of action for diverse pharmacological properties thus *H. vittatum* flowers extract-based nanoemulsion can be utilized in management of various diseases.

CONFLICT OF INTEREST

Authors declare for none conflict of interest...

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