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Formulation & Evaluation of Niacinamide Liposomes in Aloe Vera Gel

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KEYWORDS

Aloe vera gel, niacinamide, Carbopol, soya lecithin, In vitro drug release

ABSTRACT: This study aims to formulate and evaluate niacinamide-loaded liposomes incorporated into an aloe vera gel base. By combining the advantages of liposomal encapsulation and aloe vera gel, the developed formulation seeks to enhance the stability, skin delivery, and efficacy of niacinamide, providing a superior skincare product for cosmetic and therapeutic applications.

OBJECTIVES: To create a new dosage, form out of novel drug delivery. The study aims to formulate and evaluate niacinamide-loaded liposomes incorporated into an aloe vera gel base to enhance the stability and efficacy of niacinamide for topical application.

Methods: Niacinamide liposomes were formulated using the ethanol injection method and subsequently characterized for their particle size, zeta potential, invitro drug release etc. These liposomes were then integrated into an aloe vera gel base. The resulting formulation was assessed for various physical attributes, including homogeneity, pH, in vitro release behavior & antimicrobial test.

1.Introduction A liposome is a small artificial vesicle spherical in shape, having at least one lipid bilayer. Due to their hydrophobicity and/or hydrophilicity, biocompatibility, particle size and many other properties, liposomes can be used as drug delivery vehicles for administration of pharmaceutical drug [1]. Liposomes are the most often composed of phospholipid and cholesterol[2], but may also include other lipids, such as those found in egg and phosphatidylethanolamine, as long as they are compatible with lipid bilayer structure. A liposome design may employ surface ligands for attaching to desired cells or tissues[3].

Liposomes were incorporated into aloe vera gel due to aloe vera's soothing and anti-inflammatory properties, which help alleviate sunburn. Aloe vera gel also has cooling effects, moisturizes the skin, accelerates wound healing, combats signs of aging, reduces infections and acne, and lightens facial blemishes.

Niacinamide, a popular ingredient in skincare products, is valued for its skin-brightening and hydrating effects. It contributes to a smoother, softer, and more radiant complexion. Compared to traditional drug delivery systems, liposomes offer enhanced properties, including targeted delivery, controlled or sustained release, protection of active ingredients from degradation and clearance, improved therapeutic outcomes, and reduced toxicity. They also facilitate better skin penetration of active ingredients.

Niacinamide, also known as vitamin B3 and nicotinamide, is a water-soluble vitamin that collaborates with the skin's natural substances to minimize the appearance of enlarged pores, tighten stretched pores, even out skin tone, soften fine lines and wrinkles, reduce dullness, and strengthen the skin barrier.

2.Materials & Methods

Material:

The niacinamide, Carbopol, soya lecithin and other drug materials are purchased by Newneeta chemicals Pune. All the solvents used are of HPLC grade.

Preparation of aloe vera gel containing niacinamide liposomes

Preparation of aloe vera gel

Remove the pulp from the aloe vera leaf and grind it properly. It forms liquid solution. Mix Carbopol and aloe vera in 1:1 proportion for formation of gel base. Add sodium benzoate as a preservative in it.

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Preparation on liposomes:

Liposomes were prepared by using ethanol injection methods. Soya lecithin, cholesterol and niacinamide mix it in ethanol to prepare a homogeneous mixture. This mixture is then transfer in micro syringe and added in phosphate buffer solution having pH 6.8 which was placed on magnetic stirrer at the 2ml/min rate. The temperature was set above the 55°C with 100 rpm. After addition of all the solution of into phosphate buffer the whole solution is place on the magnetic stirrer for 3-4 hrs.

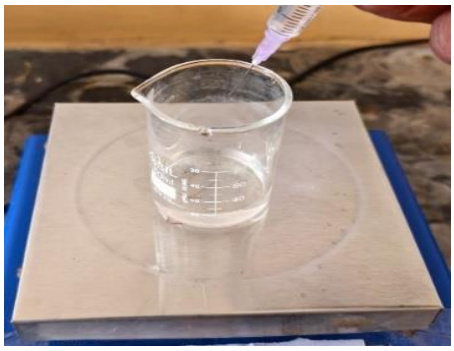

Figure 1: Ethanol injection method

Formulation of loaded aloe vera gel loaded with niacinamide liposome:

Prepared niacinamide liposomes were then mix properly in aloe vera base to form aloe vera gel loaded with niacinamide liposome. A different trial batches were performed which were mention in table no 1.

Table 1: Formulation of aloe vera gel of Niacinamide liposomes

Ingredients	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**
Niacinamide (mg)	40	40	40	40	40	40
Soya lecithin (mg)	50	100	150	200	400	600
Cholesterol (mg)	50	100	150	50	100	150
Aloe Vera gel (ml)	5	5	5	5	5	5
Carbopol 940(mg)	0.02	0.04	0.06	0.08	0.08	0.10
Water (ml)	10	9	8	6	7	5
Ethanol (ml)	10	10	10	10	10	10
Glycerine (ml)	1	1	1	1	1	1

3. Characterization

Physical appearance and smoothness

The prepared liposomes gel was subjected to visual examination to evaluate their colour, odour, and texture. The smoothness of the gel formulation was tested by rubbing between the fingers and observes whether the gel is smooth, clumped, homogenous or rough.

Calibration of Niacinamide

Calibration curve was constructed in phosphate buffer at pH 6.8 at concentration rang of 0.2 to 0.8µg/mL.

Drug content

To determine the drug content of gel, take 1gm of gel dissolve in 100 ml water and filter it. Then the filtrate is examined under UV spectrophotometer, absorption was measured and the drug content was determined.

Particle size

It can be determined by measuring the random changes in the intensity of light scattered from a suspension or solution. Small particles in suspension undergo random thermal motion known as Brownian motion. The particle size of optimized batch was checked by HORIBA scientific SZ – 100.

Light from the laser light source illuminates the sample in the cell. The scattered light signal is collected with one of two detectors, either at a 90 degree (right angle) or 173 degrees (back angle) scattering angle. The obtained optical signal shows random changes due to the randomly changing relative position of the particles.

Zeta potential

It is a measure of the charge on a particle surface in a specific liquid medium. This value of surface charge is useful for understanding and predicting interactions between particles in dispersion. Zeta potential is measured on the SZ-100V2 using the technique of electrophoretic light scattering where particle motion is detected in an applied electric field. The zeta potential of optimized batch was checked.

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pH

1.0 g gel was accurately weighed and dispersed in 100 ml purified water. The pH of the dispersion was measured using digital pH meter, which was calibrated before use with standard buffer solution. The measurements of pH were done in triplicate and average values were calculated.

Spreadability

It is the term expressed to denote the extent of area to which formulation readily spreads on application to skin or affected part. The therapeutic efficacy of a formulation also depends upon its spreading value. To determine the spreadability of formulation, 0.5 g of gel was placed within a circle of 1 cm diameter pre-marked on a glass plate of 20 × 20 cm, over which a second glass plate was placed. A weight of 500 g was allowed to rest on the upper glass plate for 5 min. The change in diameter due to gel spreading was noted.

Homogeneity

The developed formulations are being tested for homogeneity by visual inspection after the gel had been filled in the container. They were tested for their appearance and presence of any aggregates.

In vitro drug release studies

A Franz diffusion cell featuring a receptor compartment capacity of 60 ml was utilized for conducting in vitro drug release experiments.

A 1 gm of niacinamide liposomal gel were placed membrane filter. The receiver compartment was consisting of phosphate buffer having pH6.8. At a predetermine time period a solution from the receiver compartment is removed and replaced with fresh buffer. Absorbance was checked with the help of UV method and invitro drug release from niacinamide liposomal gel were calculated.

Antimicrobial test

Nutrient agar medium & agar agar dissolved in 100ml of distilled water. Allow it to cool & 20ml of agar medium was poured into each petri plates (one is control and another plate should contain niacinamide liposomal gel) and allowed to solidify. Take 0.1ml of bacterial culture (salmonella) and spread on the surface of the medium. Then all plates were incubated at 37°C for 24 – 28 hrs.

4. Results and Discussion

Physical appearance

The physical appearance of niacinamide gel were recorded in table no 2.

Table no.2. Physical appearance

Formulation code	Texture	Odour	Colour
F1	Liquid	Odourless	Transparent
F2	Slightly thin	Odourless	White
F3	Thick	Aromatic	Slightly Green
F4	Thin gel	Typical aloe	Yellow
F5	Gel	Aloevera extract	Greenish yellow
F6	Thick gel	Aromatic	Dark green

Calibration of niacinamide

The calibration curve of niacinamide were done in Phosphate buffer 6.8 in the conc. range of 0.2 to 0.8 µg /ml. The absorbance was measured at 262 nm. A graph of absorbance vs time was platted and its showing a linear relationship with R^2 0.9965.

Drug content

The drug content was carried out using UV spectroscopic method at 262nm. The drug present in 1 gm gel was found to be 3.05 mg.

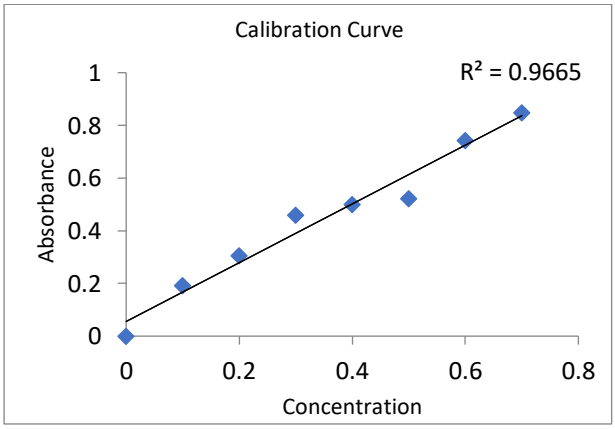

Figure 2: calibration curve of niacinamide in PBS 6.8

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Particle size

The particle size of niacinamide liposomes was found to be 711.8nm.

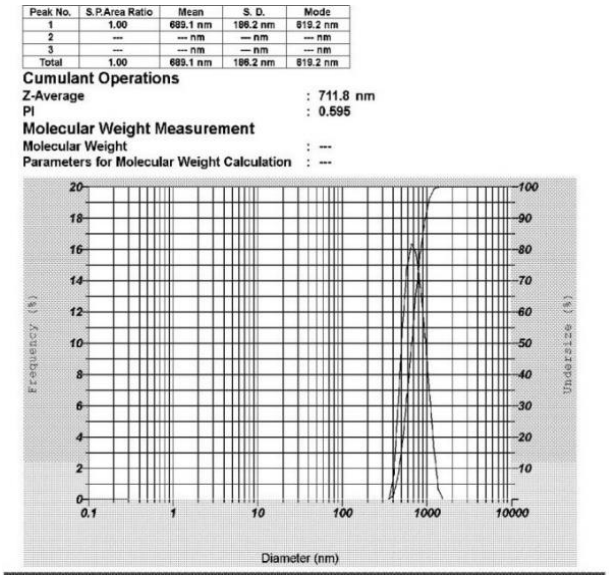

Figure 3: Particle size of optimized batch

zeta potential

The zeta potential value of formed liposome shows -29.4 mv. The negative charge is due to large hydroxyl group present on cholesterol and niacinamide. The value -29.4 mv indicates a good stability.

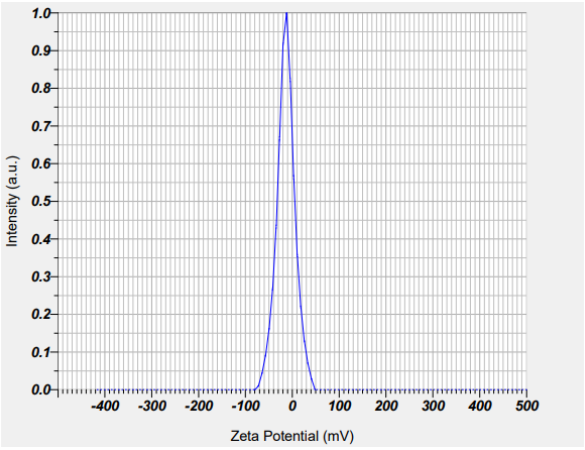

Figure 4: Zeta potentail of optimized batch

pH

The pH of prepared aloe vera gel containing niacinamide was check by using PH meter. It was recorded in table no.3.

Table no 3: pH of different batches

Formulation code	Result
F1	3.5
F2	3.7
F3	4.5
F4	5.2
F5	6
F6	6.4

Spreadability

The spredability of prepared aloe vera gel containing niacinamide was check. It was recorded in table no.4

Table no 4: Spredability of different formulation

Formula	Spreadability
F1	5.5
F2	5.9
F3	6.2
F4	6.3
F5	6.5
F6	6.9

Homogeneity

The homogeneity of prepared aloe vera gel containing niacinamide was check. It was observed that prepared niacinamide liposomal gel was homogeneous.

In vitro drug release study

The in vitro drug release from liposomal gel were carried out by using Franz diffusion cell apparatus. The in-vitro drug release from formulated niacinamide liposomal gel show a sustained released action as compare to the pure drug.

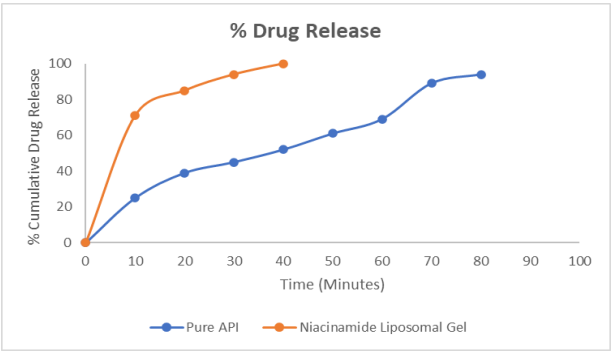

Figure 5: % Drug Release

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Conclusion:

Niacinamide shows a wide cosmetic action on skin. Liposomes have a good partitioning from the skin. Aloe vera is an herbal moisturizing agent. Formulating niacinamide liposomes in aloe vera gel enhances stability, skin penetration, and therapeutic efficacy of niacinamide. The combination provides synergistic benefits, like improved hydration, reduced inflammation, and enhanced skin barrier function. Characterization confirms optimal particle size, high stability and invitro drug release. Overall, this formulation shows promise for effective, safe skincare applications.

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