Research Article…

Research on: Preparation and Development of Topical Nano Emulsion Gel of for Treatment of Skin Inflammatory Curcuma Aromatica Diseases

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Abstract:
This work focuses on the development and testing of a topical Nano emulsion gel containing Curcuma aromatica extract, which is known for its powerful anti-inflammatory and antioxidant capabilities. The Nano emulsion was created utilizing a spontaneous emulsification approach, with parameters like surfactant content, oil phase, and droplet size optimized for better skin penetration and stability. The adjusted Nanoemulsions were then mixed into a gel base to ensure proper consistency and skin contact duration. Physicochemical characterizations such as particle size measurement, zeta potential, pH, viscosity, and in vitro drug release were carried out. The formulation was also tested for skin irritation, anti-inflammatory efficacy, and stability under different storage conditions. The results showed that the Curcuma aromatica nano emulsion gel outperformed traditional formulations in terms of drug delivery, anti-inflammatory efficacy, and skin friendliness. This work demonstrates the promise of Nanoemulsions-based topical solutions as an effective and natural treatment for inflammatory skin conditions.
Keywords: Curcuma aromatica, Nanoemulsions, Antioxidant, Development.

1. Introduction:

Nanoemulsions have been proved excellent drug carrier systems for drug local targeting through dermal sites or skin. Their lipophilic nature offers several advantages of modifications, thus resulting in the accumulation of drugs at cutaneous site and their extended delivery. The role of Nanoemulsions-based local drug delivery becomes of vital importance in conditions like infections, skin cancer, and psoriasis. Various mechanisms are there for the delivery of drugs through the ardent stratum corneum by Nanoemulsions. Surfactants and cosurfactants of the Nanoemulsions can decrease the diffusional obstruction of the stratum corneum by virtue of their inherent penetration enhancer's activity. Similarly, Nanoemulsions have a good contact with the skin surface owing to their low surface tension and small size. The drugs permeation from Nanoemulsions can be enhanced by customizing the affinity of the entrapped drugs to the internal phase in Nanoemulsions to favor partitioning into stratum corneum. Moreover, the enhanced drug solubilizing capacity of the Nanoemulsions can also increase thermodynamic activity toward the skin.

Novel drug delivery provides sustained action at a predetermined rate, constant zero order kinetics, and efficient drug level in the body. The uniform distribution of the multiple unit dosage forms

along the skin could results in more reproducible drug absorption and reduced risk of local irritation; this gave birth to local dermal sustained drug delivery and led to development of lipids nano vesicular carriers. modern age, with the significant increase in the amount of UV radiation has led to a surge in the increase incidence of skin cancer.

Nano emulsions were obtained when the size of an emulsion globule reaches approximately20–500 nm. The small droplet size can resist the physical destabilization caused by gravitational separation, flocculation, and/or coalescence. It has also avoided the creaming process because the droplet's Brownian motion is enough to overcome the gravitational separation force. Plant polysaccharide has been shown to be useful for the construction drug delivery systems for specific drug delivery.

2. **Nano emulsion gel:**

Nanoemulsions gel which known as the formation of nano emulsion based on hydrogel is the addition of nano emulsion system intergraded into hydrogel matrix which influences a better skin penetration. This mixture of Nanoemulsions gel has attracted the attention of many scientists for the development of numerous drugs that function to treat various kinds of skin disorders. A nano emulsion gel is not a new type of formulation and is already present in the market as. On the other hand, nano emulsion gel or micro emulsion gel formulations that had been prepared before. The formulation of nano emulsion gel for the topical delivery system acts as drug reservoirs which, influence the release of drugs from the inner phase to the outer phase and then further onto the skin. This release mechanism depends on the composition of the network polymer chains and the crosslink density. Besides that, the ability of a drug to permeate the skin and successfully release of therapeutic agent is influenced by drug affinity to diffuse out from the vehicle and permeate through barrier. Nanoemulsions gel on intact with skin will release the oily droplets from the gel network. The oil droplets then will penetrate into the stratum corneum of the skin and directly deliver the drug molecules without a transfer via hydrophilic phase of nano emulsions.

3. **Advantages of Nano emulsion gel:**

- The ability to resist First-pass metabolism.
- Effectiveness for a managed and long-term drug delivery system has been proven.
- Skin friendly.
- Appropriate for self-medication.
- Patients accept it quickly.
- Nano emulsion provides large surface area and free energy which make an efficient
- delivery system.
- Emulsion defect like Creaming, phase separation, flocculation, and coalescence is not
- found in nano emulsion.
- Nano emulsion prepared in variety of formulations, foams, creams, sprays and much
- other cosmetic formulation.
- It is safe on transdermal application due to its non-toxic nature.
- By using biocompatible surfactant in nano emulsion formulation, it can be
- administered orally.
- It shows better penetration of drug because the nano-sized particles can easily enter
- by the rough skin surface.

4. **Disadvantages of Nanoemulsions gel:**
   - Bubbles formed during nano emulsion formulation.
   - For utilization in pharmaceutical application, surfactant used ought to be nonpoisonous.
   - Possibility of allergenic reactions.
   - Skin irritation on contact dermatitis.
5. **Characterization of Nano emulsion:**
   - Viscosity.
   - Ph.
   - Spread ability.
   - Skin irritation test.
   - Drug Content.
   - In vitro Permeation Study.
   - Study of drug release kinetics.
   - Comparison of Nano emulsion with marketed products.
   - Stability Study.
6. **Objective:**
   - Formulation and Evaluation of curcuma aromatica Nano emulsion for the treatment of skin inflammatory diseases to improve the bioavailability and reduces the dose and thereby side effects of the drug.
   - To Improve the solubility of Curcuma aromatica's active ingredients, which are typically hydrophobic, to ensure better absorption through the skin.
   - Utilize the small droplet size of the Nano emulsion to facilitate deeper penetration into the skin layers, targeting the inflammation more effectively.
   - Leverage the anti-inflammatory properties of Curcuma aromatica to reduce inflammation and provide relief from skin conditions such as eczema, psoriasis, and dermatitis.
7. **Drug and Excipient Ingredients Profile:**

Table No. 1 Ingredients Profile

Sr. No	Ingredients	Purpose
1.	Curcuma aromatica	Anti-inflammatory
2.	Surfactant (Tween 80)	Uses as a surfactant
3.	Co-surfactant (Transcutol-P)	Used co-surfactant, solubilizer, and penetration enhancer.
4.	Oil phase (Capmul MCM)	The oil phase in Nano emulsion formulations.

8. **Physical characterization and identification of** Topical Nano Emulsion Gel:

8.1 Organoleptic properties -

- Curcuma Aromatica was characterized for its organoleptic properties viz. nature, color and odors.

8.2 Melting point determination -

- Melting point of Curcuma Aromatica was determined using melting point determination apparatus. The drug was introduced into a capillary glass tube. A sufficient quantity of drug powder formed a compact column of 4-6 mm height. This capillary tube was then inserted into HICON melting point apparatus along with the calibrated thermometer. The temperature at which the drug melted was recorded.

8.3 Differential scanning calorimeter (DSC):

- The sample of Curcuma Aromatica (about 5 mg) was loaded and sealed into DSC pan with a DSC loading puncher. The sample was scanned between 30-350°C at a heating rate of 10°C/ min, under nitrogen atmosphere (60 ml/min flow rate), using a differential scanning calorimeter, Perkin Elmer pyris 6 DSC (Massachusetts, U.S.A). An empty pan was used as a reference.

8.4 Fourier Transform Infrared (FTIR) spectroscopy:

- FTIR spectroscopic analysis of the Curcuma Aromatica was carried out using Potassium Bromide (KBr) pellet technique. An accurately weighed quantity of Curcuma Aromatica (5 mg) was mixed with KBr (1:1) and later converted into a pellet using hydraulic press. The pellet was scanned between 4000 to 400 wavelengths (cm-1) to get the characteristic spectra.

8.5 Zeta potential measurement:

- The sample of 1ml was taken into disposable folded capillary cell and zeta potential was determined using zeta potential measuring instrument (ZS90, Malvern Instruments, and Worcestershire, UK). In case of zeta potential, electric field of -120 to 120V applies. Due to which particles move with a velocity related to their zeta potential. This velocity is measured using a He–Ne laser at the wavelength of 633 nm.

9. Result of Topical Nano Emulsion Gel:

Table No. 2 Organoleptic properties

Sr. No	Parameter	Inference
1.	Nature	Fine crystalline powder
2.	Color	White
3.	Odor	Odorless
4.	Taste	Tasteless

9.1 Melting point determination:

- The melting point was determined by capillary method and was found to be 124oC that was close to reported value 123-125oC.

9.2 Differential scanning calorimeter (DSC):

- The DSC thermogram of pure Curcuma Aromatica is shown in figure DSC thermogram showed a sharp endothermic peak at 125.08°C that was in agreement with the reported value 123-125°C. Thus, it could be concluded that the sample of Curcuma Aromatica was authentic and pure.

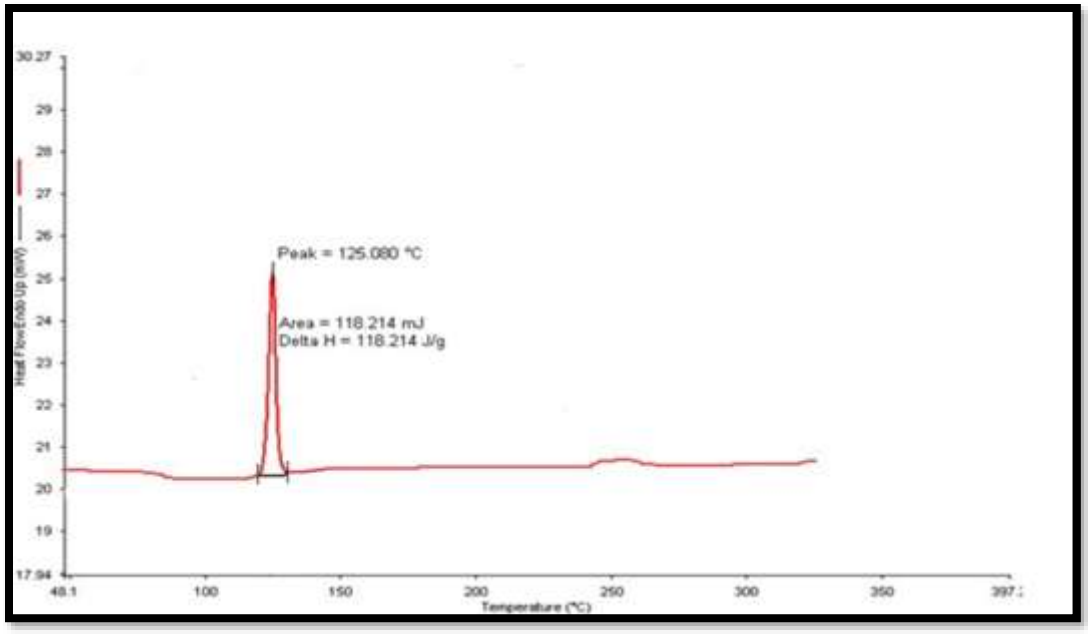

Figure 1: DSC thermogram of Curcuma Aromatica

9.3 Fourier Transform Infrared (FTIR) spectroscopy:

- The FTIR spectra of Curcuma Aromatica (figure 8) were obtained using KBr pellet technique and exhibited the characteristic peaks at 3526, 2926, 2858, 2090, 1736, 1638, 1461, 1299, 948, 588 cm-1 which were in agreement with reported spectra of Curcuma Aromatica.

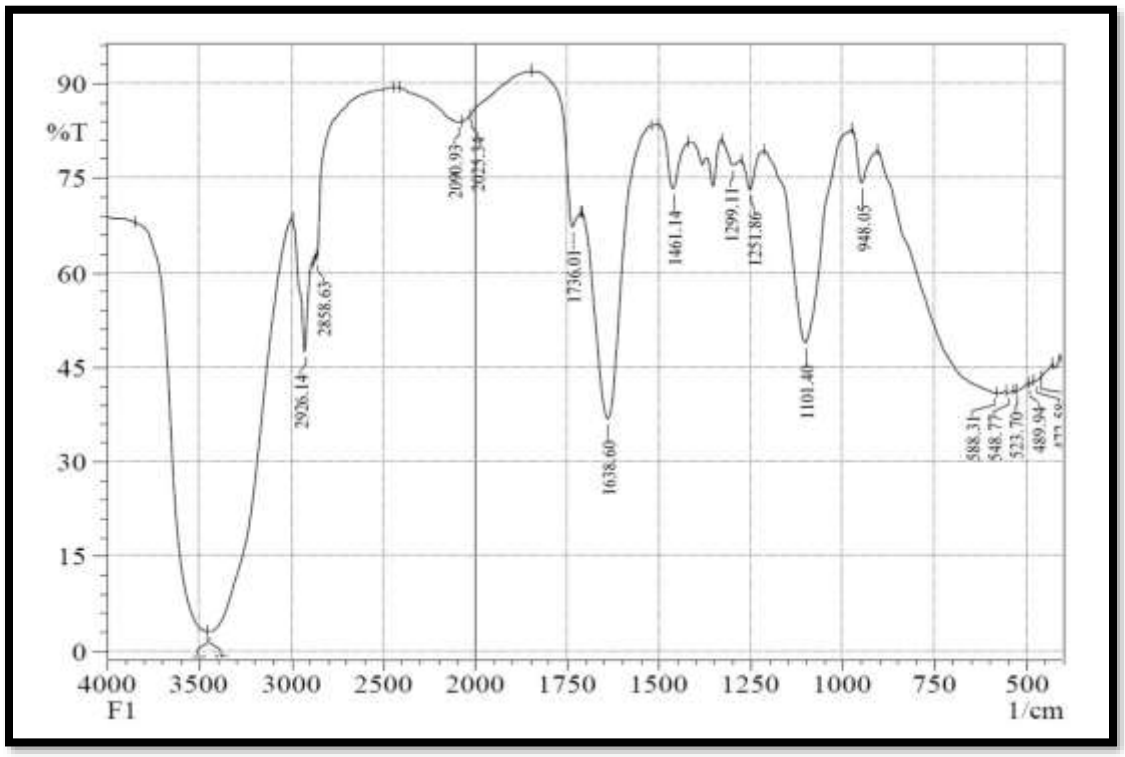

Figure 2: FTIR graph of Curcuma Aromatica

- Conclusion: The sample of Curcuma Aromatica thus characterized on the basis of its physicochemical properties such as melting point determination, DSC analysis, and FTIR spectra and was found to have properties similar to reported values thus confirming the authentic character and purity of drug.

9.4 Physical stability testing of Nanoemulsions:

Nanoemulsions are considered to be kinetically stable systems which are produced at a particular concentration of oil, surfactant and water, with no sign of phase separation, creaming or cracking. Optimized Curcuma Aromatica loaded nano emulsion was subjected to different stress/thermodynamic stability tests like heating-cooling cycle, centrifugation study and freeze-thaw cycle. It was observed that there was no sign of instability such as precipitation, phase separation, creaming, cracking and coalescence during these stress/thermodynamic stability tests.

9.5 Zeta potential measurement:

The sample of 1ml was taken into disposable folded capillary cell and zeta potential was determined using zeta potential measuring instrument (ZS90, Malvern Instruments, and Worcestershire, UK). In case of zeta potential, electric field of -120 to 120V applies. Zeta potential of optimized formulation was -24.4 ± 0.67 mV.

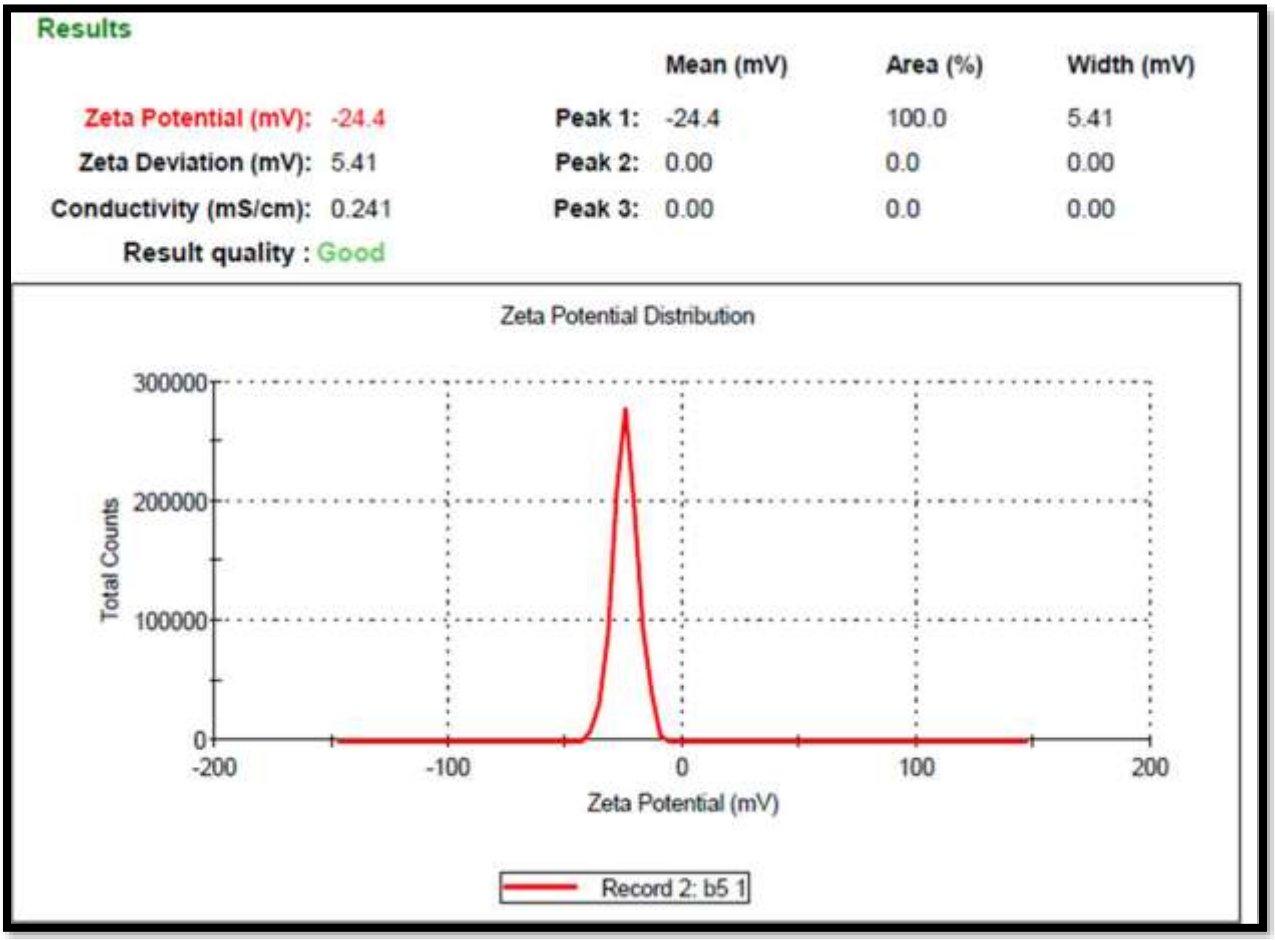

Figure 3: Zeta potential of optimized Nano emulsion formulation.

10. Conclusion:

- Extraction of active compounds from Curcuma aromatica is successfully carry out.
- Formulation of a nano emulsion using suitable oils, surfactants, and co-surfactants is prepared.
- Incorporation of the nano emulsion into a gel base to improve viscosity and spread ability.
- Characterization of the formulation for parameters like globule size, zeta potential, stability, and drug release parameter are tested.
- For storage stability study, the optimized NEs were kept at a temperature of 40 ± 2ºC and 75 ± 5% RH for three months. Samples were withdrawn after specified time intervals (0, 30, 60 and 90 days) and examined visually for any physical change in the formulation. Globule size, zeta potential and % transmittance was determined at the end of 0, 30, 60 and 90 days. These parameters were slightly increased with respect to time but the changes in the observed parameters were not found to be statistically significant ($p>0.05$).
- From the physical properties and identification tests of the drug sample is concluded that Topical Nano Emulsion Gel for Treatment of Skin Inflammatory disease is produce satisfactory results.

11. Conflict of Interests:

- The authors declare that they have no known competing financial interests or personal relationship that could have appeared to influence the work reported in this paper.

12. Acknowledgment:

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