# NANOEMULSION: A POTENTIAL FORMULATION OF IMPETIGO

**ANSHU*, T.S EASWARI**

Department of Pharmacy,
IIMT College of Medical Sciences,
IIMT University Meerut, U.P
250001, India.

Address for Correspondence:
Name- Anshu

***Abstract*: This is a novel study that demonstrated that salicylic acid can be formed into nanoemulsions for the treatment of Impetigo. The nanoemulsion area was raised using a pseudo ternary phase diagram, and the oil, surfactant, co-surfactant ratio was elevated. By using the spontaneous self-emulsified approach, an optimized salicylic acid-loaded nanoemulsion was effectively generated and characterized for viscosity, droplet size, and transmission electron microscopy (TEM). The optimized nanoemulsion was then mixed with Polyethylene glycol to create a nanoemulsion that would make it easier to apply for the medicine superficially. Particle size in the produced nanoemulsion range from 100nm to 500nm. In vitro for up to 12 hours, medication relief was investigated. Further compatibility experiments were carried out to validate any drug-polymer interaction, and it was observed that there were no distinctive peaks, indicating that there is no substantial drug-polymer interaction. The formulation had a release rate of 51.22 percent in about 12 hours. The release studies of the improved formulations. Our study demonstrated that salicylic acid can be formed into nanoemulsions for topical use in the treatment of Impetigo.**

***Keywords*: Salicylic acid, Nanoemulsion, TEM, Droplet size analysis, FTIR.**

## INTRODUCTION:

Impetigo is a bacterial skin infection this requires the outside of the dermis regularly it shows golden covering on the legs, arms, or face. They routinely occur suitable to any Staphylococcus aureus or Streptococcus pyogenes. Rarely there may be large bulla that affects the thighs. The wounds may be painful or itchy. Fever may be uncommon. There are two types of Impetigo Bullous impetigo and Non-Bullous Impetigo. Nanoemulsions are a colloidal particulate system in the submicron size range acting as a carrier of drug molecules. An emulsion is a biphasic system in which one phase is intimately dispersed in the other phase in the form of a minute droplet ranging in diameter from 0.1 to 100µm.

## Material and Method:

### Material:

All ingredients are available in IIMT University Ganga Nagar Meerut, U.P. Salicylic acid and Castor oil, Span 80, Polyethylene glycol 200(PEG). All chemicals and solvents used in this study were to analytical reagents grade. Freshly distilled water was used throughout the work.

### Preparation of Nanoemulsion:

A conventional emulsion was prepared using Salicylic acid, Castor oil, Span80, PEG200, which was added under stirring to mix. The mixture was then dispersed in water for 30 min while being stirred to form an emulsion. This emulsion was used as a benchmark. A nanoemulsion of Salicylic acid formed spontaneously in an oil phase of salicylic acid, Span80, and PEG200 (3:2:1). Various amounts of salicylic acid (10,25,50,100,250,500)were added to the 100mg of the oil phase. For two hours, salicylic acid, oil, surfactant, co-surfactant were varied at 100rpm.

**Table No 1: Preparation of Nanoemulsion**

| Oil:S/Cos | Formulation Code | Oil | Surfactant | Co-Surfactant |
|---|---|---|---|---|
| 0.5:9.5 | NA1 | 0.050 | 0.471 | 0.471 |
| 0.5:9.5 | NA2 | 0.050 | 0.625 | 0.313 |

### Morphology Of Nanoemulsion:

The morphology of nanoemulsion was observed using a transmission electron microscope. About 10ml sample was dropped in the specimen place and covered with a 400 mesh grid. After 1 min, 10ml of uranyl acetate was poured onto the grid, which was allowed to dry for 30 minutes before being examined under an electron microscope. This procedure was used to confirm the particle size in the nanoemulsion as measured using the particle size analyzer.

### Evaluation of Nanoemulsion Based PH

The PH of nanoemulsion was determined by using Lab IIMT University, PH, Meter. The PH meter probe was immersed in the container after 5ml of the sample was transferred to a beaker. The PH reading was then taken. The PH reading was then taken. The PH meter has already been calibrated before it was used to quantify the PH of the nanoemulsion. The PH of the freshly ready

formulation was measured and was used to associate the change in ph of the preparation after a specified time interval at the different temperatures studied.

**Viscosity:**
Viscosity measurements were approved out using a Brookfield viscometer and Plate rheometer(IIMT University). 20ml of nanoemulsion was a field in the cylindrical tube and the dial reading was noted at 10,20.50 and 100rpm. After then, the speed was gradually reduced, and the appropriate dial readings were recorded. The viscosity in centipoises was calculated by multiplying the dial values by the factor listed in the Brookfield viscometer catalog(Cp).

**In-Vitro Drug release and Permeation studies:**
The In-Vitro study is made using Franz Diffusion Cell Assembly. The Jacket cell had two limb reservoirs, one with the donor compartment, the other with a receptor compartment, and one with a sampling port. The diffusion cross-sectional area of the donor compartment exposed to the receptor portion is 19cm and the total capacity of the receptor compartment is 30ml. The receptor compartment is stirred throughout the study at 100 rpm using a magnetic stirrer. The temperature of the receptor middle is maintained at 37±2°C by circulating hot water in the outer jacket of the cell employing a thermostatic water circulator. The release study was carried out consuming Dialysis membrane cut-off range 12-18 KD.
The membrane was thawed and clamped in the contributor and receptor compartment of the jacketed vertical Franz Diffusion Before the permeation experiment, the cell. The receptor compartment, Phosphate buffer PH 7.4 was introduced. The nanoemulsion formulation that had been produced was applied to the membrane. The donor chamber and sampling port were covered with parafilm to avoid evaporation. Diluted samples are tested for salicylic acid using UV spectroscopy at 276nm. The research lasted 12 hours.

**Result and Discussion:**
**Pseudo-Ternary phase Diagram:**

**Figure 1: TPD of Smix ratio 1:1 (castor oil+ Span 80+PEG 200)**

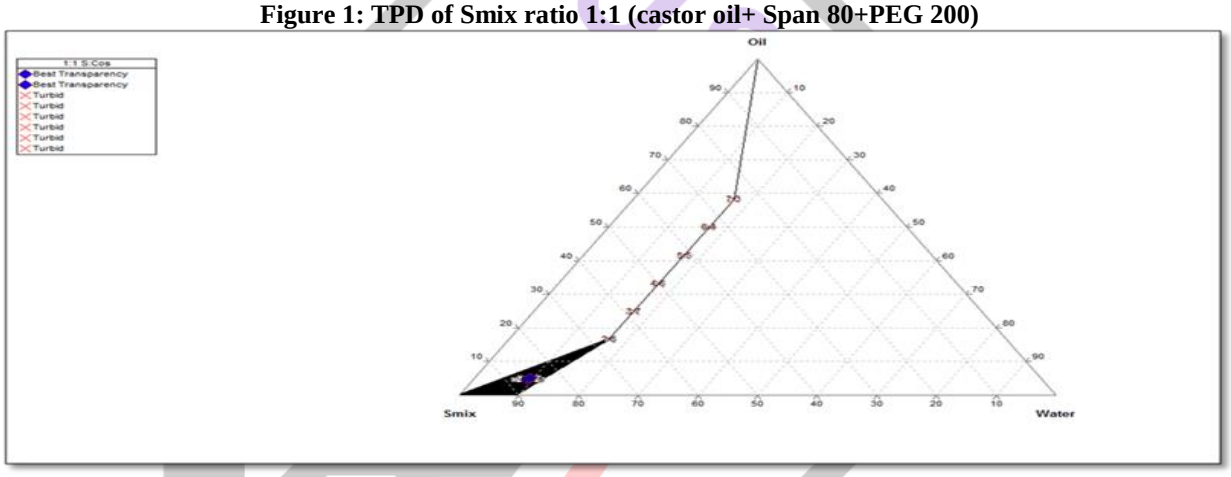
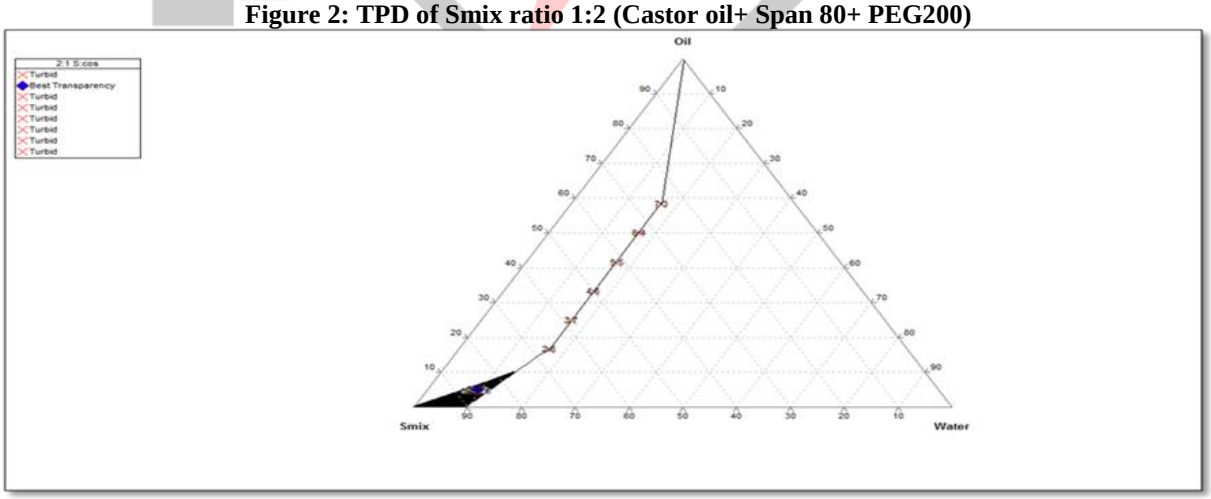



**Figure 2: TPD of Smix ratio 1:2 (Castor oil+ Span 80+ PEG200)**




**Characterization of Nanoemulsion:**

| F.C | Name of components | Smix ratio | Oil:Smix ratio | Emulsification | Visual Assessment | % T | %D.C | PH |
|---|---|---|---|---|---|---|---|---|
| NA1 | Castor oil+Span80+PEG | 1:1 | 0.5:9.5 | Rapid | Clear | 98.1% | 17.08 | 5.4 |
| NA2 | | 1:2 | 0.5:9.5 | Slow | Clear | 99.8 | 72.17 | 5.8 |

**TEM**

The morphology and arrangement of the nanoemulsion were studied utilizing a transmission electron microscope. To achieve the TEM observation, 1 ml of the nanoemulsion was diluted to 100ml using distilled water and droplets of nanoemulsion.

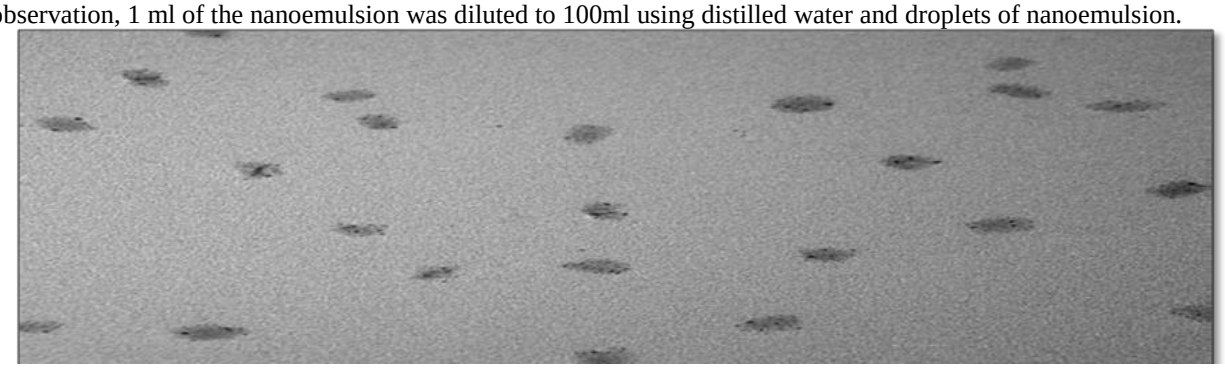


**Figure NO: 4 Result of TEM**

**Particle Size Analysis**

The particle size of Nanoemulsion was studied to decide whether it is in the range suitable for a nanoemulsion i.e less than 100nm. The result of this study is depicted the globule size of the nanoemulsion.

**Table No:2 Result of Particle Size and distribution**

| | Peak | Size(d.nm) | %Intensity | Width (d.nm) |
|---|---|---|---|---|
| Z-Average(d.nm) | Peak1 | 15.25 | 100.0 | 3.156 |
| PDL | Peak2 | 0.000 | 0.0 | 0.000 |
| Interception | Peak3 | 0.000 | 0.0 | 0.000 |

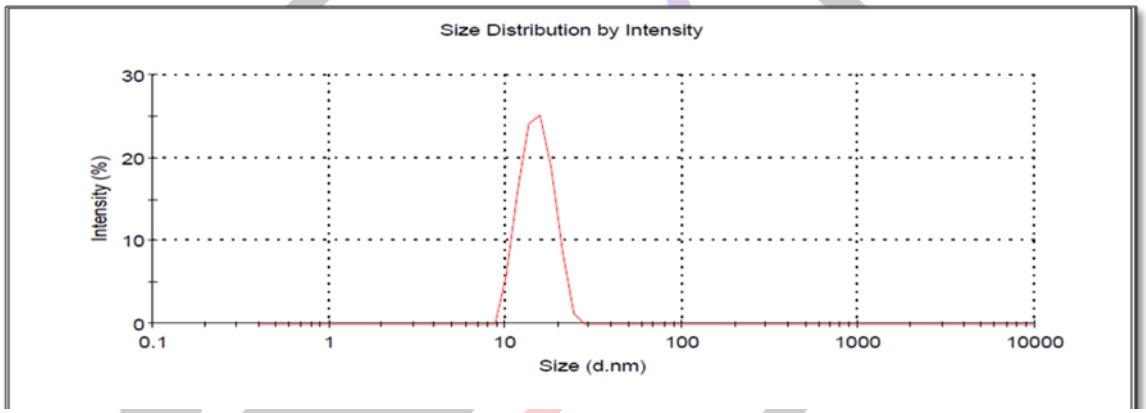



**Figure No:5 Graphical representation of particle size distribution**

**FTIR Analysis**

Structural compatibility among drug and excipients was studied with the help of FTIR spectra of drug and FTIR spectra of a mixture of drug and excipient.

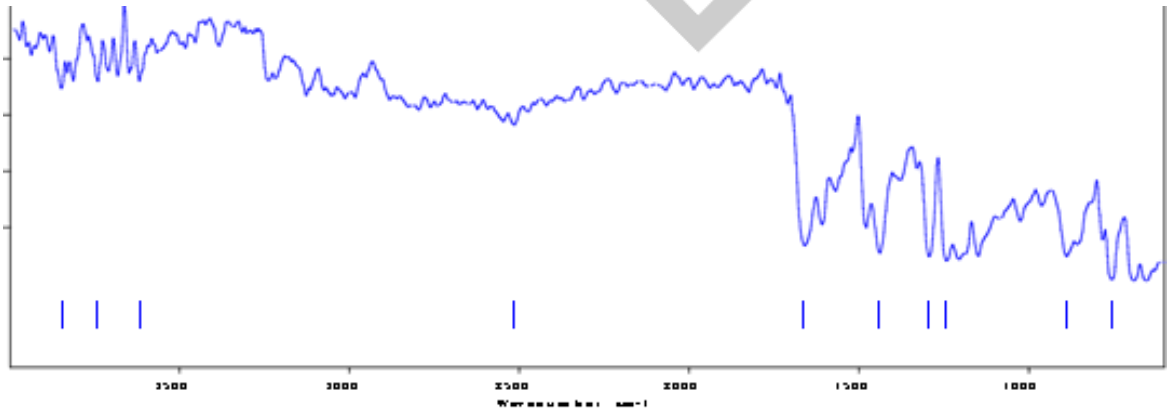
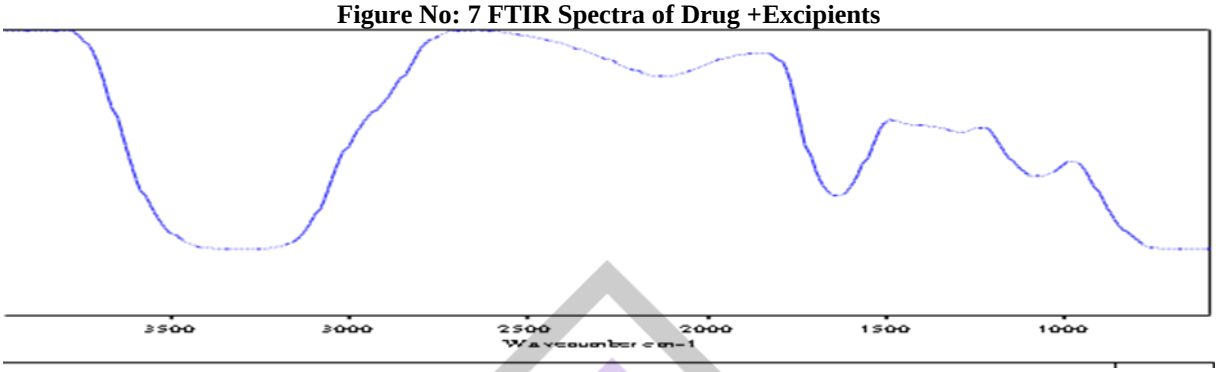


**Figure No: 6 FTIR Spectra of Salicylic Acid**

**Table No:3 FTIR analysis of drug**

| Groups | Actual value | Observed value |
|---|---|---|
| C=O | 1650-1801cm¯1 | 1668cm¯1 |
| O-H | 2400-3400cm¯1 | 2512cm¯1 |
| C-O | 1001-1400cm¯1 | 1294cm¯1 |
| C-C | 1474-1600cm¯1 | 1656cm¯1 |
| C-H | 3000cm¯1 | 2980cm¯1 |

**Figure No: 7 FTIR Spectra of Drug +Excipients**




**Optimization of NanoEmulsion:**

| Sr.No | Drug Content | % Drug Content | PH | Consistency |
|---|---|---|---|---|
| 1 | 9.862 | 98.63 | 7.4 | Gummy |
| 2 | 9.681 | 96.81 | 7.3 | Smaller viscous |
| 3 | 9.135 | 91.36 | 7.3 | Excessive viscous |

**Final Optimization Formulation:**

| Components | Quantity%(w/w) |
|---|---|
| Salicylic acid | 1% |
| Castor oil | 5.36 |
| Span80+PEG200(Smix) | 86.17 |
| Water | 8.34 |

**In-Vitro Studies:**

**Table No:6 In-Vitro drug release of formulated formulation**

| Sr.No | Time (min) | Drug release of Prepared Formulation |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 60 | 5.22 |
| 3 | 120 | 7.88 |
| 4 | 180 | 11.11 |
| 5 | 300 | 18.41 |
| 6 | 360 | 22.45 |
| 7 | 420 | 26.79 |
| 8 | 480 | 31.39 |
| 9 | 540 | 36.22 |
| 10 | 600 | 41.29 |
| 11 | 660 | 46.62 |
| 12 | 720 | 52.22 |

**Accelerated Stability Studies:**

| Formulation ($RC_1$) | Month | Appearance | pH | %Drug Content |
|---|---|---|---|---|
| 25 ± 2ºC, 60 % RH | 0 | Clear | 7.3 | 89.83 ± 0.31 |
| | 1 | Clear | 7.4 | 88.75 ± 0.64 |
| | 2 | Clear | 7.2 | 87.69 ± 0.46 |
| | 3 | Clear | 7.3 | 87.52 ± 0.73 |
| 40 ± 2ºC, 75 % RH | 0 | Clear | 7.4 | 89.95 ± 0.42 |
| | 1 | Clear | 7.2 | 89.86 ± 0.45 |
| | 2 | Clear | 7.3 | 88.79 ± 0.77 |
| | 3 | Clear | 7.1 | 88.63 ± 0.43 |

**Table No:8 Data showing stability studies of NE formulation at 50±3°C**

| Time (days) | Appearnace | PH | % Drug Content |
|---|---|---|---|
| 0 | Clear | 7.4 | 88.64± 0.53 |
| 15 | Clear | 7.3 | 87.94±0.41 |
| 30 | Clear | 7.1 | 87.57±0.72 |

**CONCLUSION:**

Nanoemulsion of salicylic acid is more acceptable for the topical route for the treatment of Impetigo. The ingredients used in the formulation are extremely stable and safe for topical delivery. Too, the study confirmed that nanoemulsion is the very likely carrier for the topical delivery of Salicylic acid revealed from the TEM and In-Vitro release study. The study revealed that for the research of a nanoemulsion the concentration of oil was reduced while selecting the mass ratio; For the development of nanoemulsion. This nanoemulsion made also presented an optimum particle size which could be enhanced along with the solubility of the API. Thus, from these conclusions it could be inferred that the objectives are reached; further studies would confirm that the irritation side effect is rejected by such formulations or it still requires any development.

**REFERENCES:**

[1] Better Health Channel. archived from the original on 5 July 2017. Retrieved 10 May 2017.
[2] Ibrahim F, Khan T, Pujalte GG. Bacterial skin infections. Prim Care. 2015 Dec 1;42(4):485-99.
[3] Hartman-Adams H, Banvard C, Juckett G. Impetigo: diagnosis and treatment. Am Fam Physician. 2014 Aug 15;90(4):229-35. PMID: 25250996.
[4] Bowen AC, Mahé A, Hay RJ, Andrews RM, Steer AC, Tong SY, Carapetis JR. The global epidemiology of impetigo: a systematic review of the population prevalence of impetigo and pyoderma. PloS one. 2015 Aug 28;10(8):e0136789.
[5] Mahé A, Faye O, N'Diaye HT, Ly F, Konare H, Keita S, Traoré AK, Hay R. Definition of an algorithm for the management of common skin diseases at primary health care level in sub-Saharan Africa. Transactions of the Royal Society of Tropical Medicine and Hygiene. 2005 Jan 1;99(1):39-47.
[6] Hartman-Adams H, Banvard C, Juckett G. Impetigo: diagnosis and treatment. American family physician. 2014 Aug 15;90(4):229-35.
[7] Mancini AJ. Bacterial skin infections in children: the common and the not so common. Pediatric annals. 2000 Jan 1;29(1):26-35.
[8] Modi JD, Patel JK. Nanoemulsion-based gel formulation of aceclofenac for topical delivery. International Journal of Pharmacy and Pharmaceutical Science Research. 2011;1(1):6-12.
[9] Nazzal S, Nutan M, Palamakula A, Shah R, Zaghloul AA, Khan MA. Optimization of a self-nano emulsified tablet dosage form of Ubiquinone using response surface methodology: effect of formulation ingredients. International journal of pharmaceutics. 2002 Jun 20;240(1-2):103-14.
[10] Chen H, Chang X, Weng T, Zhao X, Gao Z, Yang Y, Xu H, Yang X. A study of microemulsion systems for transdermal delivery of triptolide. Journal of controlled release. 2004 Aug 27;98(3):427-36.
[11] Dash S, Murthy PN, Nath L, Chowdhury P. Kinetic modeling on drug release from controlled drug delivery systems. Acta Pol Pharm. 2010 May 1;67(3):217-23.