ARTIFICIAL INTELLIGENCE GUIDED GREEN TECHNIQUE: DEVELOPMENT OF LIPID NANOPARTICLES AND ANTI-PSORIATIC ACTIVITY

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Background

- Colloidal lipid nanoparticles (CLN) has become the mainstay for the dermal drug delivery.
- CLN have established their mark as a biocompatible and biodegradable carrier, convenient for the loading of both the hydrophilic and hydrophobic drug candidates.
- However, CLN is less explored for the treatment of psoriasis, and the process of production is tedious and expensive, associated with a possibility of contamination and requirement of sophisticated instruments.

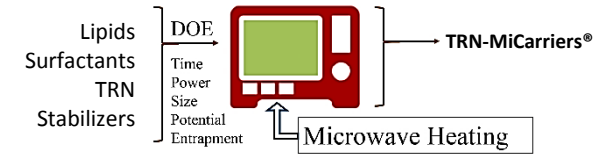
Objectives

- In the present study, the CLN (MiCarriers®) was prepared by greener and safer alternative technique using microwave irradiation.
- Tretinoin (TRN), a retinoid, was selected to be entrapped into the MiCarriers®.
- TRN-MiCarriers® acts on the fibroblast cells aiding the increase in collagen and simultaneously reducing the progression of inflammation, thus being a valuable treatment for psoriasis.

Methods

- The microwave irradiation technique was optimized by the application of artificial intelligence (AI) and machine learning (ML), to reduce the requirement of surfactants and prevent the permeation of TRN into the systemic circulation.
- The prepared MiCarriers® were optimized based on the particle size, PDI, surface potential and entrapment efficiency, and efficacy in imiquimod-induced psoriasis.

Results and Discussion



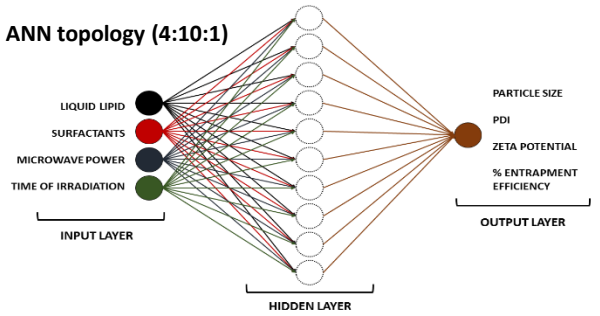
Responses obtained from Response Surface Method (RSM)

Optimized condition		Particle Size (nm)	PDI	Zeta Potential (mV)	%EE of TRN
• Solid Lipid – 60% • Liquid Lipid – 28.8% • S_{mix} – 2.1% • Power – 390 W • Time – 3 min • Desirability: 1.00	Predicted	87	0.141	-28.30	93.09
	Observed	89.12	0.143	-29.15	94.21

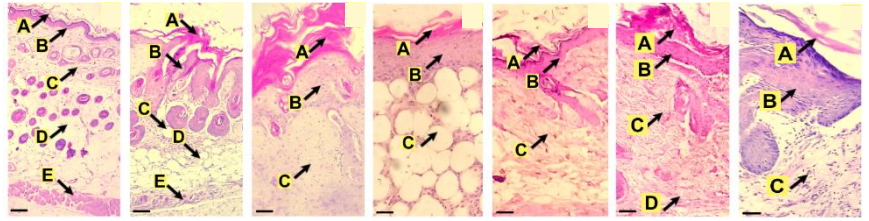
Responses from Artificial Neural Network – Genetic Algorithm (ANN-GA)

Response		Particle Size (nm)	PDI	Zeta Potential (mV)	%EE of TRN
Predicted		57.12	0.089	-40.11	99.41
Observed		55.14	0.072	-41.61	99.89
Optimized Conditions	Liquid Lipid (%)	40	26	24.5	40
	Surfactants (%)	4	3.5	4	0.15
	Power (W)	305	495	100	260
	Time (min)	5	3.5	1	2

ANN topology (4:10:1)



Anti-Psoriatic Study: Imiquimod-Induced Psoriasis in Mouse Models



Normal Skin | Disease Induced | Disease Control | Blank Cream | Standard Drug | Pure TRN | TRN MiCarriers®

A: Stratum Corneum; B: Epidermis; C: Dermis; D: Hypodermis; E: Panniculus Carnosus

- The optimized MiCarriers® had a particle size of < 80 nm, and showed a narrow size distribution, had a surface charge of < -35 mV and entrapment of > 98% for TRN.
- The AI/ML guided process produced MiCarriers® within 2 min, the MiCarriers® was stable for 12 months and limited the permeation of TRN into the bloodstream with skin retention of 87%.
- The *in vivo* studies showed a complete absence of irritation associated with the parent TRN and decreased the epidermal thickness, and the hyperkeratosis a hallmark of psoriasis. The histological features showed a remarked decrease in the accumulation of neutrophils, further confirming the non-irritancy of TRN in MiCarriers®.

Conclusion

- The study indicated that MiCarriers® produced by microwave irradiation is a greener alternative for the dermal delivery of anti-psoriatic drugs.

Acknowledgements

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