ANTIBACTERIAL POTENTIAL OF A NANOEMULSION CARRIER AGAINST SKIN MICROFLORA

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ABSTRACT

Introduction: Pharmaceutical dosage form is commonly contained with active pharmaceutical ingredients and excipients. The excipients are essential but usually exert little or no therapeutic effect. Some excipients act as carriers to deliver drugs to the absorption points or sites of action. Carrier such nanoemulsion can be formulated with additional therapeutic effect that provides multiple benefits once incorporated with intended drugs. **Aim:** The present study aims to investigate the antibacterial property of the formulated nanoemulsion carrier against selected skin microflora. **Method:** The nanoemulsion carrier was redeveloped into two separate formulations, one with phenonip and another without phenonip, based on documented formulation with the aid of an emulsifier at a high-shearing stir. Both nanoemulsion carriers were evaluated in terms of the particle size, polydispersity index, and zeta (ζ)-potential to ensure the physical stability closely similar to that previous formulation. The antibacterial capability of the redeveloped nanoemulsion carriers against skin microflora was assessed through the Kirby-Bauer well diffusion method. **Results:** Both nanoemulsion carriers appeared to be in a stable condition with particle size within the range of nanosize (<500 nm). The PDI values showed acceptable monodisperse characteristics and larger ζ-potential values were obtained suggesting a stable repulsion between particle charges. Based on the zones of inhibition (ZOI) for antibacterial assessment, both formulated nanoemulsion carriers exerted deemed antibacterial effects against *Staphylococcus aureus* (ZOI: 11.0 mm), methicillin-resistant *S. aureus* (ZOI: 7.0 mm) and *S. epidermidis* (ZOI: 6.0 mm). However, the treatment with both nanoemulsion carriers exerted no inhibition activity against *Pseudomonas aeruginosa*. **Conclusion:** Despite the deemed positive outcomes, it was suggested that the formulated nanoemulsion carriers can be utilised as a pharmaceutical carrier for transdermal or topical once incorporated with intended drugs for multiple therapeutic actions in a single application.

INTRODUCTION

- Pharmaceutical dosage forms distributed in the market are contained with active ingredient and excipients to deliver specific therapeutic action [1].
- Transdermal drug delivery system is an application of a drug onto the skin for systemic distribution in the body [2] with the aid of a formulated carrier.
- The carrier may contain additional therapeutic values to provide multiple actions in a single application.
- Hence, this present study is conducted to indicate the antibacterial activity of a nanoemulsion carrier on human skin microflora.

METHODOLOGY

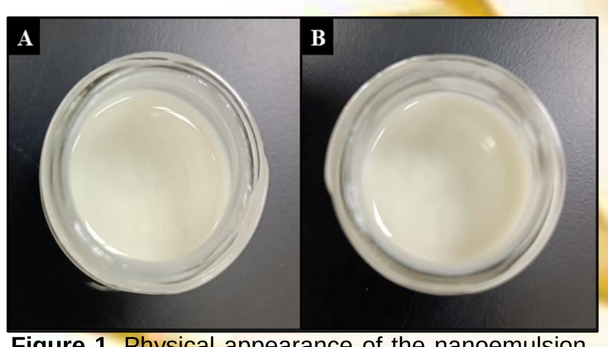

Figure 1. Physical appearance of the nanoemulsion carriers (A) with phenonip and (B) without phenonip.

1 Redevelopment of novel nanoemulsion carrier

The nanoemulsion carrier (Figure 1) was redeveloped according to a documented formulation [3].

2 Physicochemical and stability analyses

Organoleptic assessment
Particle size determination
Polydispersity index
Zeta (ζ)-potential

3 Sterility testing

4 Kirby-Bauer Well Diffusion Assay

Sample volume: 50 µL
Bacteria: *S. epidermidis*, *S. aureus, MRSA, Pseudomonas aeruginosa*
+ve control: Gentamicin
-ve control: Normal saline

RESULTS

Table 1. Organoleptic properties of the nanoemulsion carrier.

Organoleptic properties	Colour	Odour	Texture
NEC-P	White	Earthy nutmeg scent	Opaque, smooth, and non-gritty
NEC	White	Earthy nutmeg scent	Opaque, smooth, and non-gritty

NEC-P: Nanoemulsion carrier with phenonip. NEC: Nanoemulsion carrier without phenonip.

Table 2. The physical properties of the nanoemulsion carriers.

	NEC	NEC-P
Particle size (nm)	249.30 ± 34.12[a]	229.60 ± 2.51[a]
Polydispersity index	0.232 ± 0.015[a]	0.266 ± 0.004[b]
ζ-potential (mV)	-54.8 ± 6.2[a]	-20.5 ± 0.4[b]

NEC-P: Nanoemulsion carrier with phenonip. NEC: Nanoemulsion carrier without phenonip Data presented were mean ± standard deviation (n=3). Superscripted letter (a–b) across column indicates significant different at p<0.05.

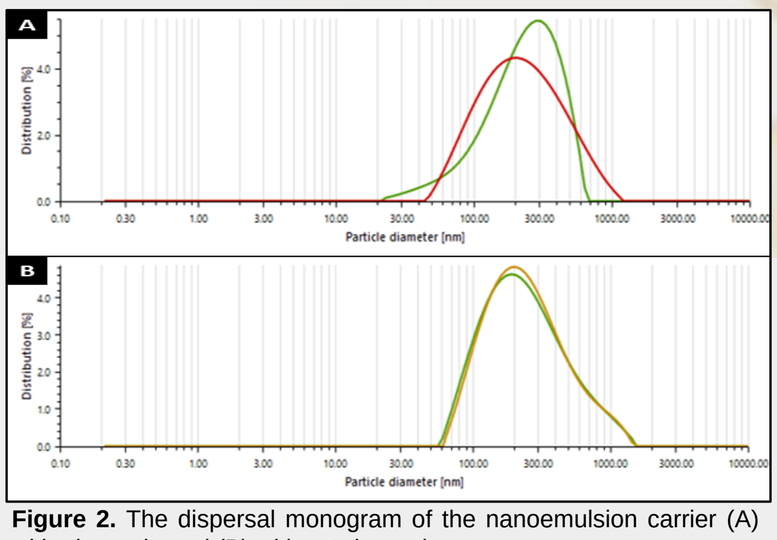

Figure 2. The dispersal monogram of the nanoemulsion carrier (A) with phenonip and (B) without phenonip.

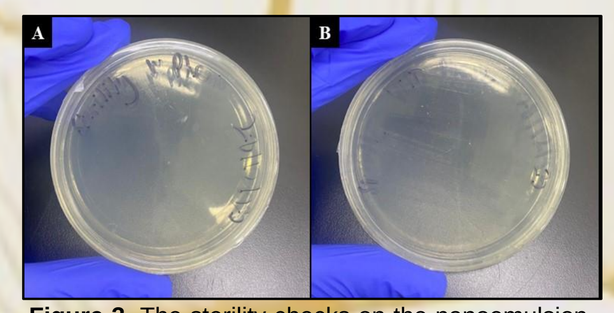

Figure 3. The sterility checks on the nanoemulsion carrier (A) with phenonip and (B) without phenonip.

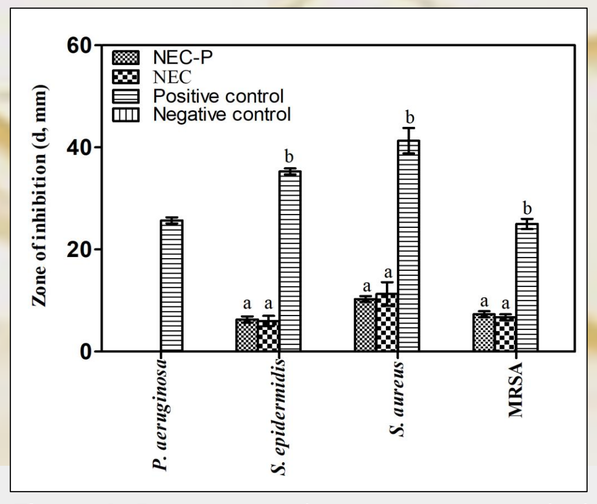

Figure 4. Data presented were mean ± standard deviation (n=3). Superscripted letters (a–b) between samples indicate significant different at p<0.05. NEC-P: Nanoemulsion carrier with phenonip. NEC: Nanoemulsion carrier without phenonip. Positive control: Gentamicin. Negative control: Normal saline. Tested samples at 50 µL of nanoemulsion carrier volume.

DISCUSSION AND CONCLUSION

- The redeveloped nanoemulsion carriers appeared in a stable condition similar to that original formulation [3].
- Low percentage of phenonip content in the formulation did not contribute to the antibacterial effect.
- The antibacterial effect is probably coming from the plant-based oils used in the emulsion formulation [4].
- It was suggested that the formulated nanoemulsion carriers can be utilised as a pharmaceutical carrier for transdermal or topical once incorporated with intended drugs for multiple therapeutic actions in a single application.

REFERENCES

1. Hannan, P. A., Khan, J. A., Khan, A., and Safiullah, S. (2016). Oral dispersible system: A new approach in drug delivery system. *Indian Journal of Pharmaceutical Sciences*, *78*(1), 2–7.
2. Kitaoka, M., Wakabayashi, R., Kamiya, N., and Goto, M. (2016). Solid-in-oil nanodispersions for transdermal drug delivery systems. *Biotechnology Journal*, *11*(11), 1375–1385.
3. Musa, S. H., Basri, M., Fard Masoumi, H. R., Shamsudin, N., and Salim, N. (2017). Enhancement of physicochemical properties of nanocolloidal carrier loaded with cyclosporine for topical treatment of psoriasis: in vitro diffusion and in vivo hydrating action. *International Journal of Nanomedicine*, *12*, 2427–2441.
4. Nirmala, M. J., Durai, L., Gopakumar, V., and Nagarajan, R. (2020). Preparation of celery essential oil-based nanoemulsion by ultrasonication and evaluation of its potential anticancer and antibacterial activity. *International Journal of Nanomedicine*, *15*, 7651–7666.