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Enhancing SLNs performance: combining commercial lipids with biobased ILs

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INTRODUCTION

The exploration of biocompatible and sustainable materials for nanotechnology-based formulations with pharmaceutical and cosmetic applications is rapidly expanding.

Among these formulations, solid lipid nanoparticles (SLNs) have garnered significant attention due to their biocompatibility and potential to enhance transcutaneous penetration, rendering them suitable for skin applications. However, they present some issues, such as low stability.

On the other hand, biobased ionic liquids (ILs) are versatile compounds, known to improve the incorporation of sparingly soluble compounds, improve stability or enhance the permeation across the skin barrier. Therefore, their incorporation in nanodelivery systems has the potential to improve the overall properties of nanoparticles.

AIMS & STRATEGY

This work aimed to produce and evaluate the performance of SLNs incorporating choline-based ILs. Thus, different SLNs were prepared using two commercial lipids - Gelucire® 43/01 and Precirol ATO® 5. Moreover, (2-hydroxyethyl)trimethylammonium phenylalaninate - [Cho][Phe] - was incorporated in both types of SLNs.

The nanosystems were characteried concerning size, polydispersity index, and zeta potential. Stability studies were conducted for 90 days. Additionally, the impact of the nanoparticles on cell viability was also evaluated using the HaCaT cell line via MTT assay.

METHODS

Preparation of SLNs

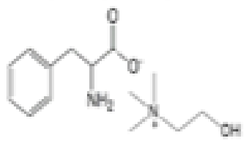
Solid Lipid
Gelucire® 43/01 or Precirol ATO® 5

+

Surfactant
Tween® 80

+

Ionic liquid
[Cho][Phe]



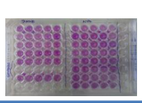
Melting and sonication → SLN

Characterization and storage stability

- Particle Size
- Polydispersity Index (PDI)
- Zeta potential (ZP)

Storage stability - during 90 days

Impact on cell viability



Cell model: HaCaT

MTT assay
(24 h exposure)

RESULTS & DISCUSSION

All SLNs prepared in the presence of Precirol ATO® 5 presented lower particle size compared with the formulations produced in the presence of Gelucire® 43/01 (**Table 1**). Additionally, the particle size of SLNs made of Precirol ATO® 5 are more suitable for topical application.

In the presence of [Cho][Phe], the size of the nanoparticles increased or decreased in the case of Gelucire® 43/01 or Precirol ATO® 5, respectively (**Table 1**). These data show that the impact of ionic liquid is dependent on the solid lipid used to prepare the SLNs.

Table 1: Physicochemical properties of the produced solid lipid nanoparticles in the presence of commercial lipids, Gelucire® 43/01 or Precirol ATO® 5, with and without ionic liquid (IL), (2-hydroxyethyl)trimethyl ammonium phenylalaninate [Cho][Phe]. Values presented as mean ± standard deviation, n=3.

Lipid	IL	Size (nm)	PDI	Zeta potential (mV)
Gelucire® 43/01	-	355.1 ± 2.6	0.32 ± 0.01	-30.62 ± 1.47
	[Cho][Phe]	570.1 ± 66.9	0.31 ± 0.02	-28.34 ± 0.71
Precirol ATO® 5	-	122.3 ± 0.8	0.26 ± 0.01	-15.68 ± 0.41
	[Cho][Phe]	82.3 ± 0.3	0.25 ± 0.01	-20.41 ± 2.63

The developed formulations demonstrated PDI values between 0.25 and 0.32 (**Table 1**), suggesting that all SLNs displayed a reasonable uniform size distribution, with better results using Precirol ATO® 5.

Regarding zeta potential, the values are around -29 mV for the formulations with Gelucire® 43/01, so these formulations may present higher colloidal stability than those produced with Precirol ATO® 5 (**Table 1**).

The storage stability was performed for 90 days, the data showed that all formulations produced in the presence of the IL maintained the evaluated parameters (particle size, PDI, and ZP) similar to the values at time 0. However, the particle size and ZP increased, during the storage time, for the formulations prepared without [Cho][Phe].

The HaCaT cell viability was around 90% for all produced SLNs, with and without IL, so the incorporation of the IL to the nanosystems did not impact the viability of keratinocytes.

CONCLUSION

In conclusion, the production of innovative lipid nanocarriers combined with biobased ILs seems to open a new paradigm for skin delivery. Data showed that ILs' impact depends on the solid lipid used to prepare SLNs. These results show that ILs can modulate the particle size of SLNs, which may contribute to improve their physicochemical properties towards a topical application. Moreover, ILs were found to contribute for the colloidal stability of the nanosystems.

FUTURE WORKS

More studies are ongoing to understand the impact of the incorporation of ILs on the SLNs, especially in the presence of bioactive compounds, such as release and permeation through the skin. Other ILs or ILs classes will also be analyzed.

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