LIPEX® SheaSolve™ as a solubilizer of organic UV filters

Abstract

The solubility of organic UV filters within the emollient phase of sun care formulations is critical for ensuring optimal UV protection and long-term stability. In this study, we investigated the solubility of three widely-used organic UV filters—Butyl Methoxydibenzoylmethane (Parsol 1789), Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S), and Ethylhexyl Triazone (Uvinul T150)—in LIPEX® SheaSolve™, a sustainable shea butter-derived emollient, and compared it against four commonly used emollients in sun care. Using a UV-Vis spectrophotometric method, we quantified the solubility of each UV filter across a range of concentrations. The results demonstrated that LIPEX® SheaSolve™ as a natural emollient still performs on par with conventional emollients such as Coco Caprylaye/Caprate. This suggests that LIPEX® SheaSolve™ offers a promising, bio-based alternative to traditional synthetic emollients, such as C12-15 Alkyl Benzoate, while maintaining the solubility and stability required for high-performance sun care products. These findings position LIPEX® SheaSolve™ as a valuable ingredient for formulators seeking to replace synthetic components with natural alternatives without compromising product efficacy.

Introduction

The efficacy of sun care products relies heavily on the stability and solubility of organic UV filters within the emollient phase. Organic UV filters in powder presentation, such as Butyl Methoxydibenzoylmethane (Parsol 1789), Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S), and Ethylhexyl Triazone (Uvinul T150), are frequently used due to their broad-spectrum protection. However, their optimal performance is contingent upon achieving full solubilization in the emollient matrix. Insufficient solubility may result in crystallization or precipitation over time, which can compromise the Sun Protection Factor (SPF) and reduce the photostability of the formulation.

Traditionally, synthetic emollients such as C12-15 Alkyl Benzoate have been favored for their ability to effectively solubilize UV filters. However, increasing consumer demand for sustainable, naturally derived ingredients is driving formulators to seek alternatives that can deliver equivalent or superior functional performance while adhering to environmental and ethical standards. In this context, LIPEX® SheaSolve™, a shea butter-derived emollient, presents a promising bio-based option for replacing conventional emollients in sun care formulations.

Objectives

The aim of this study is to compare the solubility of three commonly used organic UV filters — Butyl Methoxydibenzoylmethane (Parsol 1789), Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S), and Ethylhexyl Triazone (Uvinul T150) — in LIPEX® SheaSolve™ and compare the results to four other commonly used emollients in sun care applications.

Study design

The most frequently used emollients in commercial sun care formulations were identified through Mintel data. Four emollients, including LIPEX® SheaSolve™, were selected for comparison with three UV filters. AAK in collaboration with Q&Q Labs, a quality control laboratory based in Mölndal Sweden to develop a UV spectrophotometric method for assessing the solubility of the filters in each emollient.

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Methodology

To assess the solubility of selected organic UV filters in various emollients, a UV-Vis spectrophotometric method was employed. The study utilized a range of widely used UV filters in combination with several commonly employed emollients, as detailed in Table 1.

Table 1. UV filters and emollients included in this study.

Trade name	Supplier	INCI name	Function
Parsol 1789	DSM	Butyl methoxydibenzoyl methane	UV filter
Tinosorb S	BASF	Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine	UV filter
Uvinul T150	BASF	Ethylhexyl Triazone	UV filter
Akomed R	AAK Sweden AB	Caprylic/Capric Triglycerides	Emollient
Cetiol CC	BASF	Dicaprylyl Carbonate	Emollient
Cetiol LC	BASF	Coco-Caprylate/Caprate	Emollient
LIPEX SheaSolve	AAK Sweden AB	Shea Butter Ethyl Esters	Emollient
Tegosoft TN	Evonik	C12-15 Alkyl Benzoate	Emollient

The preparation of standard solutions was conducted by dissolving each UV filter in isopropanol across a defined concentration range. This process facilitated the development of calibration curves, which were critical for ensuring accurate quantification of the UV filter solubility in each emollient. The calibration curves were constructed by analysing known concentrations of each filter to establish a reference for comparison against test samples.

A selection of five emollients, including the shea-derived LIPEX® SheaSolve™, was evaluated for their solubilizing capacity in combination with the UV filters — Butyl Methoxydibenzoylmethane (Parsol 1789), Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S), and Ethylhexyl Triazone (Uvinul T150). These emollients were chosen based on their prevalence in commercial sun care formulations and their potential for maintaining the stability of organic UV filters in sunscreen applications.

Preparation of standards

Six standards with known concentrations of each UV filter in the emollients are prepared. The standards are prepared using a concentration range from 0.000025-0.02 w/w% for Parsol 1789 and Tinosorb S and 0.000018-0.02 w/w% for Uvinul T150. The standards are diluted with isopropanol.

Perparation of samples

A 40 w/w% solution of the UV filter in the emollient was prepared by shaking the sample for 5 days at room temperature, then centrifuged and filtered to create a saturated solution. The sample was then diluted with isopropanol to reach the concentration of the standard curve according to Table 2.

Table 2. The dilution ranges of samples containing Parsol 1789, Tinosorb S and Uvinul T150.

	Dilution step 1		Dilution step 2	
	Volume sample (µL)	Volume IPA (µL)	Volume sample Dil 1 (µL)	Volume IPA (µL)
Parsol 1789 and Tinosorb S	100	900	50	950
Uvinul T 150	100	900	50	950

	Dilution step 3		Dilution step 4	
	Volume sample Dil 2 (µL)	Volume IPA (µL)	Volume sample Dil 3 (µL)	Volume IPA (µL)
Parsol 1789 and Tinosorb S	100	900	100	900
Uvinul T 150	100	900	100	1300

A Varian Cary 50 UV-Vis spectrophotometer is used to measure the absorbance for all samples. The samples and their respective standards are run in one sequence using a new cuvette for each measurement. As the concentration of the samples are unknown, samples from both dilution steps 3 and 4 are analyzed and the sample with the highest absorbance within the calibration curve is used for calculations. The concentration of this sample is then back calculated by multiplying with the dilution factor.

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Results

The solubility of the UV filters in the emollients can be found in Figure 1.

Solubility of organic UV filters in various emollients

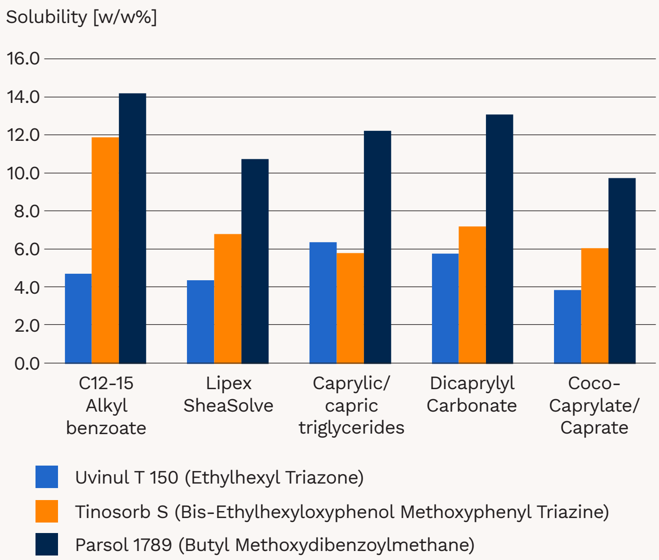

Figure 1. Solubility of three organic UV filters in emollients. The data is an average of two replicates.

A significant background absorbance was noted only for samples using LIPEX® SheaSolveTM. The method had to be slightly adapted with the purpose of compensating for the noise so that the results shown in Figure 1 only refers to the solubility of the UV filter.

Discussion

The solubility of organic UV filters in emollients is crucial for the efficacy and stability of sun care formulations. This study evaluated the solubility profiles of three UV filters — Parsol 1789, Tinosorb S, and Uvinul T150 — across various emollients, including LIPEX® SheaSolve™, C12-15 Alkyl Benzoate, and Caprylic/Capric Triglycerides. The results demonstrated significant solubility variations, with C12-15 Alkyl Benzoate effectively solubilizing both Parsol 1789 and Tinosorb S, supporting the importance of selecting emollients that enhance UV filter solubility.

LIPEX® SheaSolve™ showed the capacity to solubilize all three UV filters without significant precipitation. Its unique composition, derived from shea butter ethyl esters. This characteristic positions LIPEX® SheaSolve™ as a promising alternative to traditional synthetic emollients, enabling formulators to create effective, stable, and sustainable sunscreen formulations.

The observed solubility discrepancies highlight the need for formulators to conduct thorough compatibility studies during product development, especially when incorporating natural ingredients. The growing demand for sustainable formulations underscores the relevance of using naturally derived emollients that provide both performance and environmental benefits.

Conclusions

The solubility analysis of three organic UV filters — Butyl Methoxydibenzoylmethane (Parsol 1789), Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (Tinosorb S), and Ethylhexyl Triazone (Uvinul T150) — in five distinct emollients demonstrated that solubilization behavior varies significantly depending on the UV filter and the emollient system. C12-15 Alkyl Benzoate showed superior solubilization of Parsol 1789 and Tinosorb S, while Caprylic/Capric Triglycerides exhibited the highest solubility for Uvinul T150. These results indicate that traditional synthetic emollients can offer selective solubilization advantages depending on the formulation context.

Moreover, LIPEX® SheaSolve™ — a naturally derived shea butter ethyl ester — was found to solubilize all three UV filters effectively. The overall performance of LIPEX® SheaSolve™ positions it as a technically viable alternative to synthetic emollients. Its ability to solubilize multiple UV filters across a broad spectrum without precipitating or compromising the UV protection factor is of particular interest in formulation design.

The data supports the inclusion of LIPEX® SheaSolve™ in sun care formulations focus in sustainability and naturality as a multifunctional emollient capable of providing effective solubilization while meeting the growing demand for sustainable, bio-based ingredients. This versatility makes it a suitable replacement for synthetic emollients, especially in formulations where maintaining UV filter solubility and long-term stability is critical to achieving high SPF performance and consumer safety.

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