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EFFECT OF EMOLLIENT ESTERS ON SOLUBILIZING AND PREVENTING RECRYSTALLIZATION OF ORGANIC UV ABSORBERS, AND DISPERSING INORGANIC UV FILTERS IN SUNSCREEN FORMULATIONS

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Introduction:

Ultraviolet (UV) filters are the key ingredients in sunscreen formulations protecting the skin. New generation of organic UV absorbers (Bis-Ethylhexyloxyphenol Methoxyphenyl Triazine (BEMT), Diethylamino Hydroxybenzoyl Hexyl Benzoate (DHHB), and Ethylhexyl Triazone (EHT)) requires proper solvents to facilitate the formulation process and ensure stability over time [1-7]. On the other hand, inorganic particulate UV filters such as Titanium Dioxide (TiO2) and Zinc Oxide (ZnO) require efficient dispersants to ensure the incorporation of adequate inorganic particulates into the formulation [8].

The objectives of the present study were first to investigate the performance of emollients in solubilizing crystalline UV absorbers and preventing their recrystallization in the formulation, secondly to evaluate the dispersing properties of emollients for inorganic UV particulates, and finally to assess the effect of emollients on the performance of UV filters *in vitro*.

Materials & Methods:

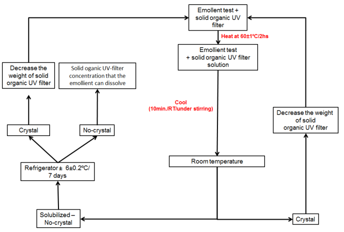

Figure 1: Schematic diagram of solubility test

Table 1: (A) Organic UV filter-based oil-in-water emulsion for recrystallization and in vitro UV performance analysis. (B) Inorganic UV particulate-based oil-in-water emulsion for in vitro UV performance analysis.

(A)	Ingredient	BMDBM	DHHB	EHT
			Weight %	
Water phase	Deionized water		To 100	
	EZ4U		0.3	
	SSE-20		1.0	
	Glycerin		5.0	
	PEHG		0.5	
Oil phase	Organic UV filter	3.0	5.0	5.0
	Emollient		10.00	
Additive phase	NaOH (18% solution)		pH 5.5	

(B)	Ingredient	TX	ZX	Micro-ZnO
			weight%	
Water phase	DI water		72.2	
	Glyceryl Stearate, PEG-100 Stearate		2.0	
	Xanthan Gum		0.3	
	Glycerin		5.0	
	PEHG		0.5	
Oil phase	Inorganic UV filter		5.0	
	Emollient		15.0	

Results & Discussion:

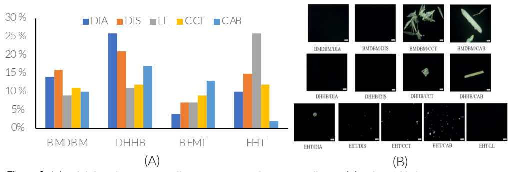

Figure 2. (A) Solubility chart of crystalline organic UV filters in emollients. (B) Polarized light microscopic photo (×500 magnification) of organic UV filter-based O/W emulsions at 25 °C after 5 Freeze/Thaw cycles (-18 °C /25 °C). Recrystallization of crystalline UV filter molecules.

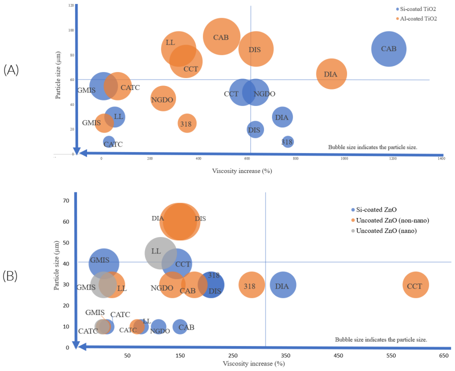

Figure 3. Bubble chart of dispersion of 30% TiO2 (A) and 30% ZnO (B) in 70% emollient bases, respectively.

Emollients provided different levels of solubilization based on the chemical nature of both emollients and UV filters. Good solubilization profiles can help prevent the recrystallization of organic UV absorbers.

The *in vitro* UVAPF test results reveal certain boosting effects of emollients on organic UV filters, which maybe because of the participation of emollient molecules in the energy dissipation of UV filter molecules when excited by the UV rays. Emollients play a role not only in stabilizing the organic UV filters but also in their efficiency.

The dispersing property of emollients for inorganic UV filters depends on the structure of metal oxides and coating technologies used to make the handling of particulates easier. Based on the dispersion study, uncoated nano-sized Zinc Oxide is one of the most difficult types to disperse. CATC and GMIS performed well regardless of the type of particulates. CATC and GMIS are emollients of medium polarity and relatively higher consistency compared with other emollients tested. They can effectively wet, disperse and stabilize the particles in the system. However, when formulated into an O/W emulsion, the selection of the emulsifier/stabilizer system will affect the overall compatibility and performance. In the system tested, GMIS displayed the best performance.

Conclusions:

Effective UV filter solubilizers and dispersants are proposed respectively, and sample sunscreen formulations are given as references with in vitro SPF/UVAPF indications. Proposed tools to study solubility, recrystallization stability, dispersion property, and in vitro SPF/UVAPF are provided for formulators who want to assess the performance of emollient esters when developing effective and stable products for sun protection.

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