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International Journal of Pharmaceutics 297 (2005) 197–203
international journal of pharmaceutics
www.elsevier.com/locate/ijpharm

The effect of packaging materials on the stability of sunscreen emulsions

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Received 3 November 2004; received in revised form 30 March 2005; accepted 30 March 2005

Abstract

The purpose of this research was to study the stability of a emulsion containing UVA, UVB and infrared sunscreens after storage in different types of packaging materials (glass and plastic flasks; plastic and metallic tubes). The samples, emulsions containing benzophenone-3 (B-3), octyl methoxycinnamate (OM) and Phycocorail®, were stored at 10, 25, 35 and 45 °C and representative samples were analyzed after 2, 7, 30, 60 and 90 days period. The stability studies were conducted by analyzing samples at pre-determined intervals by high performance liquid chromatography (HPLC) along with periodic rheological measurements.

Keywords: Cosmetic products; Emulsions; Sunscreens; Packaging materials; HPLC; Rheology

1. Introduction

Sun radiations are necessary for all living organisms, although it presents a threat to the overall health of human skin, especially through ultraviolet radiation. The mass destruction of atmospheric ozone layer presents threat to natural protection system from UV radiation and as a result a potential harmful effect on human skin (Epstein, 1990; Krutmann, 2000; Osterwalder et al., 2000; Parisi and Wong, 2000; Romanowski and Schueller, 2000; Molen et al., 2001).

In order to minimize the effects of UV radiation, the use of sunscreens in cosmetic preparations has been increasing. Many new cosmetic products containing sunscreens are being developed and are commercially available. Consequently, there is a need for development and validation of analytical methods for quantitative determination of sunscreen agents in cosmetic products. High performance liquid chromatography (HPLC) is the most used chromatographic method for qualitative and quantitative determination of sunscreen agents in cosmetic products (Rastogi and Jensen, 1998;

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doi:10.1016/j.ijpharm.2005.03.021

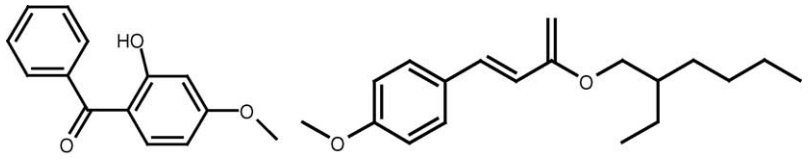

Fig. 1. Chemical structures of benzophenone-3 and octyl methoxycinnamate.

Vanquerp et al., 1999; Portad et al., 1999; Santoro et al., 2000; Scalia, 2000; Dutra et al., 2002).

The purpose of this research was to prepare emulsions containing UVA, UVB and infrared sunscreens and to study their stability after storage in different types of packaging material (glass and plastic flasks; plastic and metallic tubes). The emulsion samples containing benzophenone-3 (B-3), octyl methoxycinnamate (OM) (Fig. 1) and Phycocorail®, were stored at 10, 25, 35 and 45 °C and analyzed after 2, 7, 30, 60 and 90 days period by rheological measurements and after 2, 7, 30 and 60 days period also by HPLC in order to proceed the stability studies.

2. Material and methods

2.1. Standards, reagents and solvents

All reagents and solvents were of analytical grade or of HPLC grade. Standards: B-3 and OM (Neo Heliopan AU®) were acquired from Galena, São Paulo, Brazil. Solvents: methanol (Omnisolv®, Merck®); water from a Milli-Q® Plus Water Purification System (São Paulo, SP, Brazil); packaging materials with 60 g capacity each: glass (type II soda-lime type, treated with SO_2) and plastic (polypropylene) flasks, plastic (polypropylene) and metallic (aluminum) tubes were acquired from local industries.

2.2. Sample

The O/W emulsion used in this research was constituted of: phase A – silicone oil, 3.00% (w/w); gliceryl monostearate, 2.00% (w/w); cetostearyl alcohol, 2.00% (w/w); mineral oil, 3.00% (w/w); Polawax®, 2.50% (w/w); Chemynol®, 0.80% (w/w); BHT, 0.05% (w/w); B-3, 2.00% (w/w); OM, 4.00% (w/w); Tiosorb TG®, 2.00% (w/w); Phycocorail®, 0.50% (w/w); phase B – propyleneglycol, 5.00% (w/w); Veegum ultra®, 0.50% (w/w); xanthan gum, 0.30% (w/w); imidazolylurea, 0.50% (w/w); distilled water q.s. 100% (w/w). Placebo (emulsion base) was also prepared containing all the ingredients without the sunscreens.

The components of phase A (oil phase) were weighed and triturated in a beaker, with exception of Chemynol®. In another beaker, xanthan gum and distilled water of phase B (aqueous phase) were mixed to obtain a gel like consistency. Immediately after, other components of phase B were added to it. Phase A and phase B were heated separately until 75–80 °C. Emulsions were prepared by adding phase B into A with constant stirring. When the mixture temperature reached around 40 °C, Chemynol® was added and stirring maintained until the emulsion reached room temperature. Samples were taken and stored at room temperature (25 ± 1 °C), 10, 35 and 45 °C separately during 2, 7, 30, 60 and 90 days.

2.3. Apparatus

Liquid chromatographic system CG Model 480C, equipped with a variable UV detector, connected to an electronic integrator Model CG-200 and manual injection valve fitted with a 20 μL sample loop (Instrumentos Científicos CG Ltd., São Paulo, SP, Brazil). Rotational viscosimeter Brookfield-RVT with SC4-29 spindle and sonicator, Thornton T-14.

2.4. Methods

2.4.1. HPLC operating conditions

LiChrospher® 100 RP-18 column Merck®, particle size 5 μm, 125 mm × 4 mm i.d.; mobile phase methanol–water (87:13 v/v); flow rate of 1.0 mL/min;