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International Journal of Pharmaceutics 242 (2002) 207–211

international journal of pharmaceutics

www.elsevier.com/locate/ijpharm

Note

New microencapsulated sunscreens: technology and comparative evaluation

C. Anselmi [a,*], M. Centini [a], C. Rossi [b], M. Ricci [b], A. Rastrelli [c], M. Andreassi [a], A. Buonocore [a], C. La Rosa [a]

[a] *Dipartimento Farmaco Chimico Tecnologico and Scuola di Specializzazione in Scienza e Tecnologia Cosmetiche, Università di Siena, Via della Diana 2, 53100 Siena, Italy*

[b] *Dipartimento di Chimica e Tecnologia del Farmaco, Università di Perugia, Perugia, Italy*

[c] *Polytèch S.C. a R.L., Area Science Park, Trieste, Italy*

Received 14 January 2002; received in revised form 4 February 2002; accepted 11 February 2002

Abstract

The aim of this work is to obtain new technologically improved microencapsulated sunscreens characterised by UV-radiation stability, good substantivity, low toxicity, a better tolerability and easiness to formulation. For this purpose we prepared two different systems using semisynthetic Hyaluronic Acid (HA) benzyl ester and a synthetic polymer (patent pending). We obtained these systems using two different methodologies: emulsification/solvent evaporation and emulsification/solvent extraction. The comparison between the two formulated systems was carried out in terms of their chemical–physical and biological properties.

Keywords: Sunscreens; Microspheres; Substantivity; Technology

Many active substances of cosmetic use, such as sunscreens, hydroxyacids, skin lightners, tanners, act at the corneum layer level. The control of the concentration and distribution of the 'actives' in the corneum layer is the key to optimise their benefits.

Indeed, these sunscreen substances show a loss of their specific function when penetrating the skin surface and thus the penetration of these ingredients must be avoided. This fact must be adequately taken into account since, today, the majority of the topical products, from moisturisers to shampoos, include such ingredients (Fairhurst and Mitchnick, 1995; Nacht, 1995; Wiechers, 2000).

Sunscreen products must protect the skin against UV radiation damages. Moreover the active ingredient in sunscreen preparations should remain, as we said, on the skin for a reasonable period of time, conserving their activity despite perspiration and bathing (Lowe et al., 1997).

We designed original sunscreen systems, microspheres, which allow formulators to meet SPF goals by exposing consumers to reduced concen-

* Corresponding author. Tel.: +39-0577-232-039; fax: +39-0577-232-070

E-mail address: anselmic@unisi.it (C. Anselmi).

0378-5173/02/$ - see front matter
PII: S0378-5173(02)00159-X

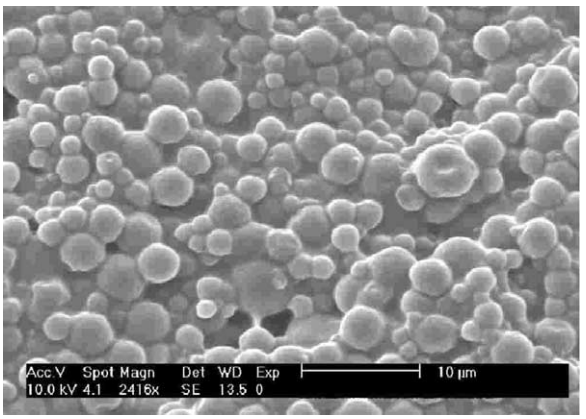

Fig. 1. Microspheres obtained using synthetic polymer.

tration of organic sunscreen compared with the traditional ones. Microspheres are homogeneous particles in which the cosmetic ingredients are dissolved or dispersed throughout the polymer matrix (Fox, 1995; Rogers, 1999).

We encapsulated commercial sunscreens in two different polymer matrixes.

The advantage of microencapsulated sunscreens are various:

- photostability;
- substantivity;
- easy to formulate;
- no contact with skin;
- wide adsorption surface: homogeneous skin distribution.

Photostability is the most important characteristic of effective sunscreens. In fact the possible sunfilter photochemical decomposition reduces the ingredient photoprotective properties and could also produce phototoxic and photoallergenic degradation products (Rieger, 1997).

The substantivity of a molecule towards keratin minimizes percutaneous absorption, a very important aspect to improve the cosmetics safety (Monti et al., 1993).

Two different systems of encapsulated sunscreens were obtained using the emulsification/solvent evaporation and emulsification/solvent extraction techniques, respectively.

In the first system we used a polysaccharide derivative based on Hyaluronic acid (HYAFF 11 kindly given by F.A.B. S.r.l.) (Benedetti, 1994; Benedetti et al., 1990) and in the second a synthetic polymer (patent pending).

HA has been widely used because of its biological properties: tolerability, biocompatibility and biodegradability.

The modification of HA chemical structure brought to the production of a series of biopolymers with significantly different chemical–physical characteristics, but with similar biological properties as tolerability, biocompatibility and biodegradability.

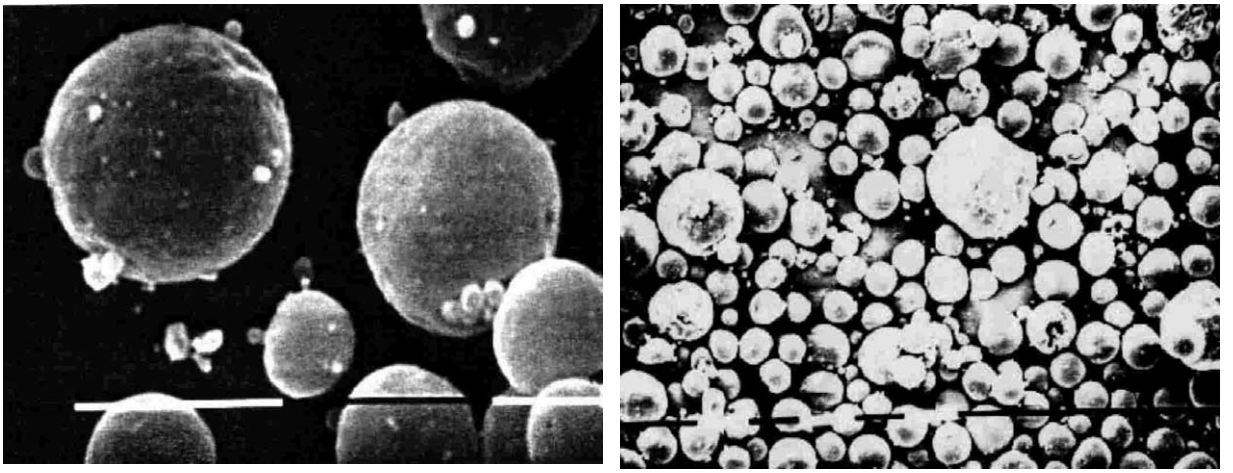

Fig. 2. Microspheres obtained using HA benzyl ester.

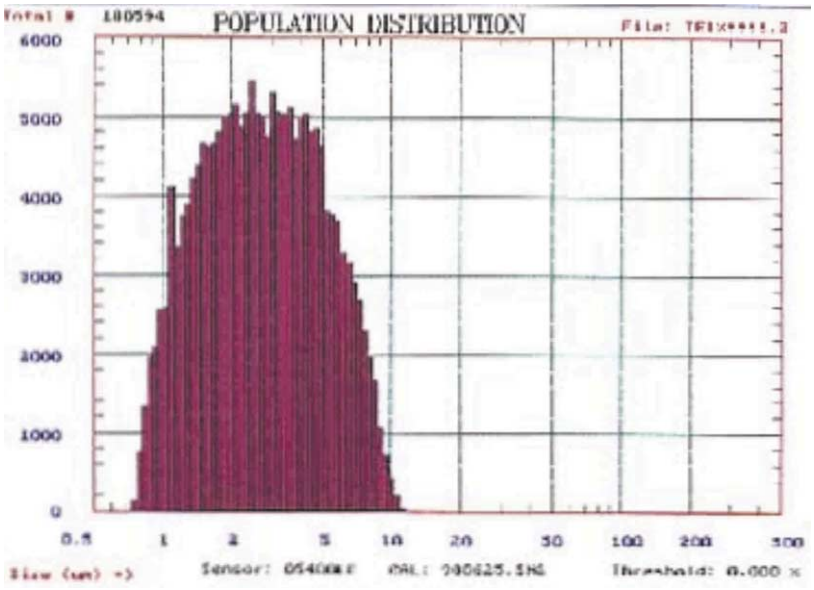

Fig. 3

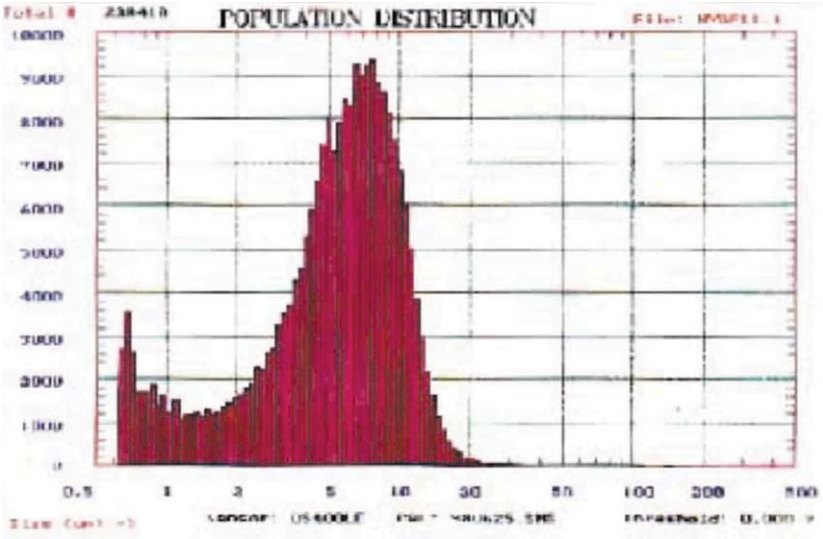

Fig. 4

Fig. 3. Dimensional analysis of synthetic polymer.
Fig. 4. Dimensional analysis of HA benzyl ester.

According to the hydrophobic affinity of the substances employed in the process, the emulsification/solvent extraction method is able to produce 10 μm size adhesive microspheres. The HA-esters are highly mucoadhesive and can be processed into microspheres, which deliver the encapsulated molecules by closely adhering to the mucosal surface and providing protection against the enzymatic inactivation (Benedetti, 1994).

Chemical–physical and biological properties of encapsulated sunscreens were evaluated and compared with those from the market.

In particular, FT-IR, HPLC/UV, thermogravi-

metric, SEM and dimensional analyses were carried out.

The comparison between the two systems was made by means of physical, chemical and biological properties like: SPF in vitro, morphology, particle size and substantivity.

Microspheres obtained by emulsification/solvent evaporation method using the synthetic polymer are shown in Fig. 1. Morphological characteristics, in different batches of microspheres produced, were evaluated as well. In both cases (Figs. 1 and 2) they appear spherical in shape with smooth surface. No valuable differences in shape and surface characteristics were found for both microspheres obtained using different polymers.

Particle size analysis was performed by Accusizer C770 granulometer on microsphere samples suspended in water. The results are shown in Figs. 3 and 4.

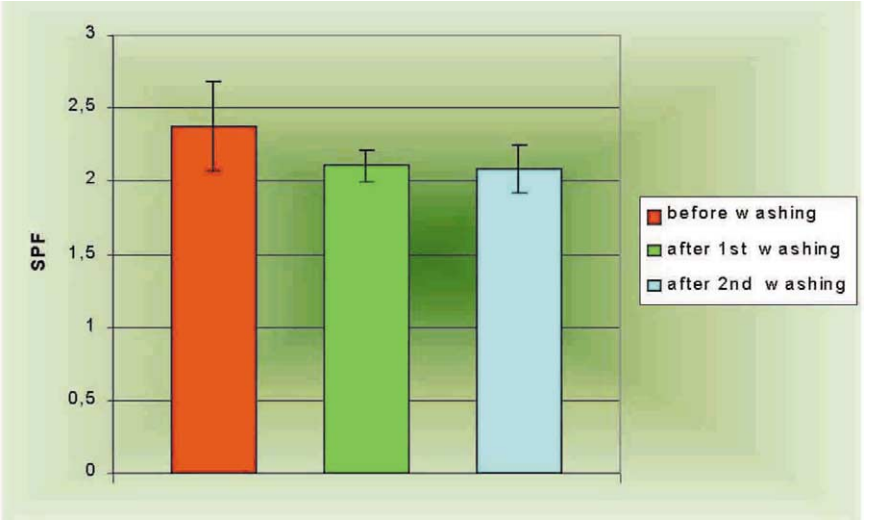

Fig. 5

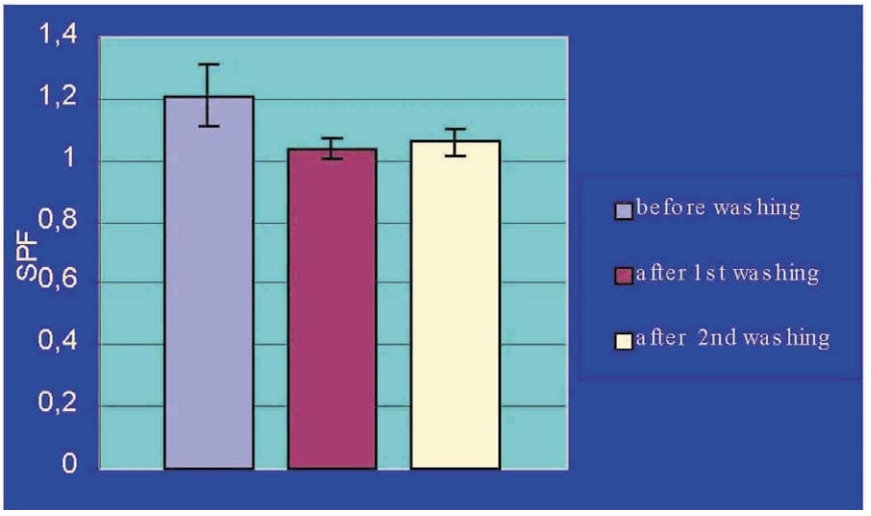

Fig. 6

Fig. 5. Microspheres of synthetic polymer 'water-resistant' test.
Fig. 6. Microspheres of HA benzyl ester 'water-resistant' test.

The substantivity was evaluated in term of water resistance properties by 'Water resistant test' performed with a method like F.D.A. test (US Food and Drug Administration, 1993), using an hydrogel containing microspheres (10% w/w). The hydrogel was applied on a substrate (2 mg/cm^2) and SPF in vitro, before and after immersion, was determined as well.

SPF measures were accomplished by using a Diffey (Diffey and Robson, 1989) equation based integrating sphere equipped spectrophotometer, which can read the transmittance of opaque samples, such as suncare products.

The test provided good results in both cases (Figs. 5 and 6), showing that microspheres are endowed with long-lasting action on the skin.

This study demonstrated that these new microspheres are safer than commercial systems and shows an enhanced skin protection activity.

Acknowledgements

This work was supported by M.I.U.R. (40%) and the framework of National Program of Research on Chemistry by the Skin Research Consorzio (CSR) M.U.R.S.T., Ref. 1211/305-129003.

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