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Characterizing Beeswax-Jojoba Oil Nanosuspensions with TIO_2 as Inorganic Sunscreen with Emphasis on different Emulsifiers

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Organic and natural ingredients have become a major trend in cosmetics due to the consumers' wish for ingredients friendly to both the skin and the environment. This is especially true for sunscreens which play an important role in natural care cosmetics used for photo protection and thus skin cancer prevention.

A nanosuspension composed of titanium dioxide as inorganic sunscreen within a matrix of carnauba wax and decyl oleate in a 2:1 ratio has previously been reported to yield a high sun protection factor (SPF) of about 60 (in vitro). To render the formulations more interesting for natural cosmetics, ingredients were replaced by more eudermic ingredients with special regard to the emulsifiers.

Methods: Nanosuspensions were produced by dispersing a lipid phase into an aqueous phase using high-pressure homogenization. The sunscreen- loaded lipid nanoparticles were analyzed by particle size measurements (PIDS technique) and SPF analyses. Transmission electron microscopy (TEM) was then used to visualize the systems after freeze fracture of the nanosuspensions and negative staining with a 2 % [w/w] solution of uranyl acetate, respectively.

Results: The replacement of carnauba wax by bees wax not only showed a narrower particle size distribution but also a high SPF of about 80. The following replacement of decyl oleate by jojoba oil also showed a narrower particle size distribution and still a high SPF of about 75. In order to replace the polysorbate 80 (polyoxyethylene (20) sorbitan monooleate) used in the aforementioned formulation, the effect of emulsifiers qualified for natural care cosmetics (sodium lauryl sarcosinate, sucrose esters and potassium stearate each 1, 2 and 5 %) was investigated. The use of sodium lauryl sarcosinate and potassium stearate showed SPFs below 30 – a higher amount of emulsifier also yielded a lower SPF. The particle size distribution also became narrower with increasing percentage of emulsifier. Formulations containing 1 % of sucrose esterified with stearic acid, palmitic acid and lauric acid showed a very broad particle size distribution up to the micrometer range. SPFs of approximately 15 for sucrose stearate and palmitate were observed. Sucrose laurate showed an SPF of about 70. Due to the high SPF while using sucrose laurate, the amount of emulsifier was increased up to 5 and 10 %. These systems showed also high SPFs about 50 and 60- even more important, the particle size distribution improved considerably.

The morphology of the TiO2-loaded nanosuspensions was visualized after freeze-fracture and negative staining transmission electron micrographs and scanning electron micrographs. A close contact between bees wax and titanium dioxide crystals was confirmed. These systems look very promising and should be further investigated.