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A New Sunscreen Agent

Ecamsule (terephthalylidene dicamphor sulfonic acid), the first new sunscreen agent to be approved by the FDA in 18 years, is now available in the US in a moisturizer called *Anthelios SX*. Ecamsule has been used in Canada and Europe for more than 10 years.

ULTRAVIOLET (UV) RADIATION — Solar UV radiation capable of injuring the skin is classified by wavelength into UVA1 (340-400 nm), UVA2 (320-340 nm) and UVB (290-320 nm). UVA, which makes up 95% of terrestrial UV radiation and penetrates into the dermis, is primarily responsible for photoaging and phototoxicity. UVB, which is largely absorbed in the epidermis, is responsible for most of the erythema of sunburn, but UVA2 is also erythemogenic. Both UVA and UVB can damage DNA, suppress immune function and cause skin cancer in animals.[1] UVB is present primarily in spring and summer in temperate climates and is strongest at midday; UVA is relatively constant throughout the day and the year.

SUNSCREEN AGENTS — Most FDA-approved sunscreen agents are organic chemicals that absorb various wavelengths of UV radiation, primarily UVB. Many sunscreen agents are not photostable in the UVA range and degrade with sun exposure.[2] To provide broad-spectrum UV protection and increase photostability, sunscreen products use combinations of several agents.

Avobenzone (also called Parsol 1789) absorbs both UVA1 and UVA2, but its efficacy has been shown to decrease by about 60% after 60 minutes of exposure to sunlight due to photoinstability.[3] **Meradimate** and **oxybenzone**, which are both active throughout the UVB range, also absorb some UVA2 wavelengths. **Octinoxate** is a potent UVB absorber. **Octisalate** is a weak UVB absorber; it is usually used with other agents to augment UVB protection. **Octocrylene** absorbs UVB; it is photostable and, when combined with other sunscreens, can improve the photostability of the entire product. The two FDA-approved inorganic **physical sunscreens**, zinc oxide and titanium dioxide, prevent penetration of human skin by UVB and both UVA1 and UVA2; micronized formulations are less visible on the skin, but may also be less effective.

Table 1. Sunscreen Agents

Agent	Maximum FDA-Approved Concentration	UV Absorbance Range (nm)*	Maximum UV Absorbancy (nm)*	Usual Use*
ORGANIC/CHEMICAL				
Avobenzone (Parsol 1789; butyl methoxydibenzoylmethane)	3%	320-400	360	UVA1
Ecamsule (Mexoryl SX)	3%	290-400	344	UVA2
Ensulizole (phenyl benzimidazole sulfonic acid)	4%	290-320	302	UVB
Homosalate	15%	295-315	306	UVB
Meradimate (menthyl anthranilate)	5%	260-380	340	UVA2
Octinoxate (octyl methoxycinnamate)	7.5%	290-320	308-310	UVB
Octisalate (octyl salicylate)	5%	280-320	305	UVB
Octocrylene	10%	250-360	303	UVB
Oxybenzone (benzophenone-3)	6%	270-350	290 & 329	UVB, UVA2
INORGANIC/PHYSICAL				
Titanium dioxide	25%	290-400**	—	UVB/UVA 1&2
Zinc oxide	25%	290-400**	—	UVB/UVA 1&2

* UVA1 = 340-400 nm; UVA2 = 320-340 nm; UVB = 290-320 nm
** UV reflection range

Table 2. Some Sunscreen Products

Product	Formulation	Active Ingredients	SPF	Size/Cost[1]
Anthelios SX Daily Moisturizing Cream with Sunscreen (La Roche-Posay)[2]	Cream	Avobenzone 2%, octocrylene 10%, ecamsule 2%	15	3.4 oz – $34.00
Alba Hawaiian Sunscreen Green Tea (Alba Organics)	Cream	Octinoxate 7.5%, benzophenone-3 6%, octyl salicylate 5%, homosalate 5%, butyl methoxydibenzoylmethane 3%	30+	4.0 oz – 9.59
Solar Sense Face & Lip Protection (CCA Industries)	Wax stick	Octocrylene 9%, zinc oxide 7.6%, octinoxate 7.5%	36	0.53 oz – 5.49
Bull Frog Fast Blast Sunblock (Chattem)	Spray	Octinoxate 7.5%, octisalate 5%, octocrylene 10%, oxybenzone 6%	36	4.7 oz – 8.49
PreSun Ultra Sunscreen (Westwood-Squibb)	Gel	Avobenzone 3%, octyl methoxy-cinnamate 5%, octyl salicylate 5%, oxybenzone 6%	15	4.0 oz – 11.49
Sea & Ski Advanced Sunscreen (Radiant Technologies)	Lotion	Octinoxate 6%, oxybenzone 3%, octisalate 3%, avobenzone 2%	30	4.0 oz – 5.99
Neutrogena Ultra Sheer Dry-Touch Sunblock (Neutrogena)	Lotion	Avobenzone 3%, homosalate 10%, octisalate 5%, octocrylene 2.8%, oxybenzone 6%	55	3.0 oz – 8.49

1. Prices according to drugstore.com, May 14, 2007.
2. Recently, the FDA approved two formulas that will be marketed as sunscreens. One contains the same active ingredients as *Anthelios SX* plus titanium dioxide 2% with an SPF of 20 (*Anthelios 20*, and others) and the other contains ecamsule 3% plus avobenzone 2% and octocrylene 10% with an SPF of 15 (*Anthelios 15*, and others).

ECAMSULE — A broad-spectrum organic agent, ecamsule is particularly effective in absorbing short UVA wavelengths (UVA2).

Clinical Studies – In laboratory tests of photostability, application of *Anthelios SX* produced residual UVB and UVA protection of 100% and 97% at 1 hour and 90% and 80% at 5 hours.[4] In a study comparing the UVA protection of 6 commercial sunscreen products with an SPF of 21 or higher, a sunscreen product containing ecamsule was statistically significantly better in preventing UVA-induced pigmentation than the products without ecamsule.[5] Sunscreens containing ecamsule have also been shown in a few small studies to be more effective than sunscreens without ecamsule in preventing photosensitivity reactions in patients with systemic lupus erythematosus (SLE) and polymorphous light eruption.[6,7]

Adverse Effects – As with other sunscreens, infrequent cutaneous irritation with erythema, itching, burning or stinging has occurred with ecamsule. Allergic contact dermatitis and photoallergic and phototoxic effects occur only rarely with currently marketed sunscreen products. In clinical trials, long-term use of sunscreens that block UVB has had only a minor effect on vitamin D levels and does not appear to induce secondary hyperparathyroidism or increase the risk of osteoporosis.[8,9]

TOPICAL ANTIOXIDANTS — Sunscreen agents do not protect against UVA-induced free-radical production.[10] Topical antioxidants are sometimes added to sunscreen products, but they generally do not diffuse well into the epidermis and tend to be unstable.[11]

SUNSCREENS AND CANCER — Sunscreens have been shown to reduce the incidence of actinic keratoses.[12] A 4.5-year randomized controlled study of 1621 adults in Australia found that daily sunscreen use reduced the risk of developing squamous cell carcinoma by 40%, but had no effect on the incidence of basal cell carcinoma. It is unclear whether sunscreens have a protective effect against melanoma.[13,14]

SUN PROTECTION FACTOR — The sun protection factor (SPF) is a relative measure of protection only against (mostly UVB-induced) erythema. It is related to the intensity and duration of sun exposure.[15] The advantage of a higher SPF sunscreen in preventing erythema may be offset if its use is accompanied by more time in the sun, producing other forms of (mostly UVA-induced) photodamage.

USE OF SUNSCREENS — Sunscreens with an SPF of at least 15 are recommended for all adults and children >6 months old. They should be applied liberally 15-30 minutes before sun exposure to allow absorption and make it less likely that the sunscreen will be washed off. About 1 oz. is recommended for an average adult wearing a bathing suit; most people generally apply about a quarter of this amount, significantly reducing the SPF.[16] Many dermatologists recommend that sunscreen be reapplied every 2 hours or after swimming, sweating or towel drying. A sunscreen that is labeled "water resistant" retains its SPF for at least 40 minutes of water

immersion in laboratory studies, and a product that is "very water resistant" protects for at least 80 minutes. UVA radiation is not filtered by clear glass; one retrospective study found that automobile drivers developed more skin cancers on their left side (head, neck, arm, hand).[17] A recent *in vitro* study in human skin found that sunscreen increases absorption of the insect repellent DEET, especially when DEET is applied first.[18] Whether this practice could cause clinical toxicity is unclear. Some travel experts recommend applying sunscreen first when using both.

SUNLESS TANNING — Dihydroxyacetone (DHA), a pigmenting agent, is a common active ingredient in sunless tanning preparations. DHA binds to the stratum corneum and changes skin color to orange-brown; the color fades after 5-7 days. It does not protect against sunburn.[19]

CONCLUSION — Sunscreens that provide UVB/UVA protection can prevent sunburn, decrease photoaging, and decrease the incidence of actinic keratoses and squamous cell carcinoma. Broad-spectrum sunscreens containing ecamsule may offer better protection against UVA-induced photodamage and possibly against some photosensitivity reactions.

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