



CapSol™ sunscreen oleosomes Natural, Multifunctional Sun Care Encapsulation and Delivery System

**Sustainable oleosomes from non-GMO safflower seeds
for skin-nourishing, SPF sun care creams and lotions**



A Natural Approach to Multifunctional, Skin-friendly Sun Care

What happens when you produce day wear and other sunscreen-containing formulations with a clean label, superior sensory properties, and moisturization benefits, in a skin-friendly profile? Without a doubt, a consumer-desirable product that meets the demands of today's discerning consumers.

CapSol™ sunscreen oleosomes make it easy to produce trend-forward creams and lotions. The 100% natural, complex organelles of safflower seeds, approximately 1 to 3 microns in size, contain oleosin proteins, a phospholipid membrane, and triacylglycerol, components that nourish skin, and at the same time, significantly reduce the amount of organic actives necessary to obtain stable, high SPF formulas.

Botaneco isolates oleosomes fully intact, without any use of solvent or chemicals to maintain the micro oil bodies as nature designed them. Leveraging nature's technology, CapSol™ allows for the ability to load a minimum of UVA and UVB filters inside the triglyceride core, and on the outer shell. Microscopic examination of the sunscreen-containing

oleosomes indicates that the organelle holds the UV filters securely on the surface, and in small oil droplets stabilized within the emulsion, providing the basis for high SPF daily wear formulas with up to 80% less organic UV filters than conventional commercial products.

Improvement in Consumer Perceptions

More government bodies, such as the United States Environmental Protection Agency, now recommend that consumers wear sunscreen year-round to protect their skin from the adverse effects of sun exposure. The American Dermatological Association recommends an SPF of 30 or higher every day that consumers may be outside, year round. To ensure consumer acceptance of high SPF formulas, and compliance with guidelines, consider formulating products with extraordinary skin feel.

One strategy to improve consumer perceptions is to formulate with fewer sunscreen actives and at the same time, advance the effect of the sunscreen technology that is applied to the skin. Reducing the amount of organic actives by up to 80% in formulas means there is less overall skin contact with sunscreens, therefore lowering the amount of potential absorption when compared with conventional formulations.

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Multifunctional Formulation Benefits

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| High SPF, Broad-spectrum Claims | Up to 80% reduction in organic actives required to achieve desired SPF |
| Prestige Aesthetics | Easy-to-produce consumer-preferred skin feel with lipid-containing-oleosomes, and lower levels of UV filters |
| Long-lasting Hydration | Triglyceride oils with high oleic acid content offer excellent compatibility with <i>stratum corneum</i> |
| Emulsification | Oleosome emulsifies up to three times its weight in oil |
| Globally Compliant | All-natural and sustainable seed oil micron-sized emulsion |

Consumer Benefits

Skin-friendly pH

Skin nourishing lipids, including natural tocopherol

Less contact and potential absorption of organic actives, given lower use-levels

Less emission of UV filters to the environment

Sustainable and natural

Sustainable Delivery of Beneficial Components, Using Less Organic Actives

CapSol™ oleosome technology is a natural micron-sized emulsion with a unique ability to efficiently hold, deliver, and release skin-nourishing ingredients and organic UV filters. When spread onto the skin's surface, the oleosomes collapse, evenly distributing their contents in a uniform film.

A high degree of distribution efficiency in conjunction with excellent film formation affords a significantly lower level of organic actives necessary to achieve high SPF, broad-spectrum creams and lotions. Comparing a commercial sunscreen formulation containing a range of UV filters to a demonstration formula containing a minimum amount of two organic actives – Octinoxate (UVB absorber) and Avobenzone (UVA absorber) – and 11.7% of CapSol™ oleosomes, both show *in vivo* SPF 30 values. The formula containing CapSol™; however, allows a significant reduction in both the type and amount of actives required to obtain the same SPF value.

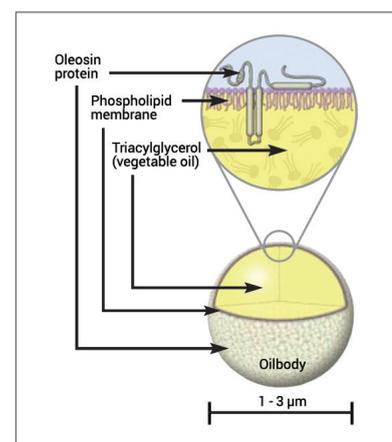
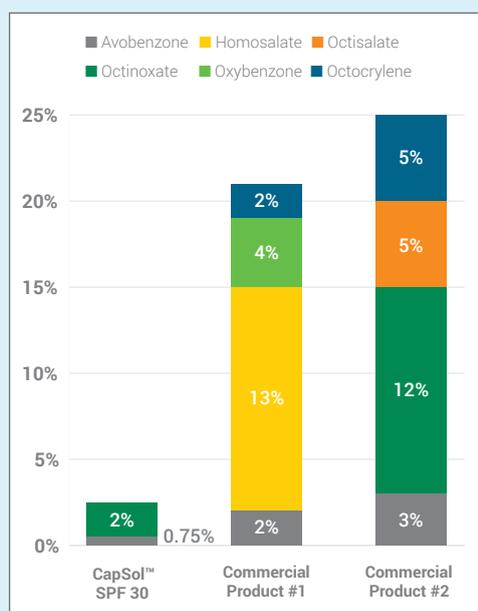


Figure 1. Organelle of safflower oilseed

Figure 2: CapSol™ SPF 30 Sunscreen vs. Commercial Sunscreen



Ingredients

PHASE A

CapSol™ 11.70

Octyl methoxycinnamate (OMC) 2.00

PHASE B

Avobenzone 0.75

Finsolv® PG-22 2.70

PHASE C

Water 80.05

PHASE D

Fragrance 0.30

Preservative 1.00

PHASE E

Artistoflex® AVC 1.50

Procedure

1. Add CapSol™ to a beaker. Begin mixing at 400 rpm and slowly add OMC. Allow to mix for 20 min.
2. Combine Phase B and heat to 40-50°C. Once combined allow to cool to room temperature.
3. Add Phase B to Phase A and allow to mix for 20 min at 400 rpm.
4. Add Phase C, increase speed to 700 rpm and allow to mix for 5 min.
5. Add Phase D and allow to mix for 15 min at 700 rpm.
6. Add Phase E, switch to side sweeping mixer and allow to mix at 140 rpm for 40 min.
7. Adjust pH to 5.5-6.0 with 40% NaOH solution.



Reproducible, Stable Formulations, by Nature!

Formulations containing 10% CapSol™, 0.75% Avobenzone and varying amounts of UVB filters were tested for SPF using a well-established Spectrophotometer SPF test method, proven reliable in oil-based systems. The *in vitro* results, shown here, indicate a high level of reproducibility and reliability when compared side by side to the United States FDA *in vivo* test method¹.

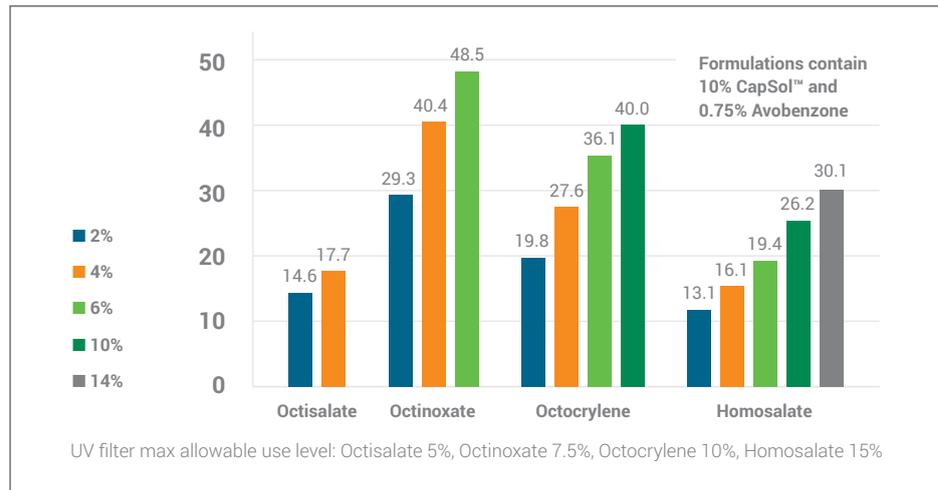


Table 1: Spectrophotometric SPF Test Method vs. *in vivo* Testing

| | 2% Octisalate | 2% Octocrylene | 2% Homosalate | 6% Octocrylene | 14% Homosalate |
|------------------------|---------------|----------------|---------------|----------------|----------------|
| Spectrophotometric SPF | 14.60 | 19.76 | 13.14 | 36.03 | 30.07 |
| ** <i>In vivo</i> SPF | 18.00 | 16.50 | 18.00 | 32.25 | 34.50 |

1. Yang, SI., Liu, S., Brooks, GJ., Lanctot, Y., Gruber, JV. Reliable and Simple Spectrophotometric Determination of Sun Protection Factor: A Case Study Using Organic UV Filter-Based Sunscreen Products. J Cosmet Dermatol. JOCD12390, Article DOI: 10.1111/jocd.12390

** *In vivo* testing was performed on a 2-person panel

Use of Commercial UV Transmittance Equipment

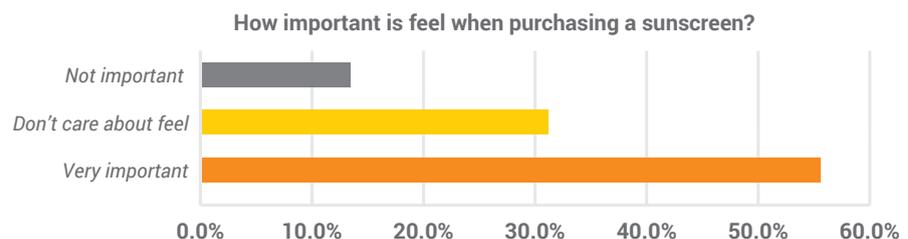
UV transmittance-based testing devices, such as Labsphere, do not always demonstrate consistent values for oleosome-based formulations. It is recommended to use the UV absorbance method described in the paper by Yang *et al* (*Reliable and simple spectrophotometric determination of sun protection factor: A case study using organic UV filter-based sunscreen products*) to make correlations to clinical SPF measurements prior to actual human testing.



Ultra-light Hydration, Naturally

More consumers than ever before are aware that sun exposure contributes to dry, rough skin. CapSol™ oleosomes are unique in sun care in that they allow a reduction in the required levels of UV filters, using only natural technology; and, at the same time, improve formulation skin-feel and hydration. As the oleosomes spread evenly on the skin's surface, they release triglyceride emollient oils, which have been shown to be non-comedogenic and compatible with the stratum corneum. A uniform distribution of emollient oils from oleosomes support hydration, a value proposition in line with consumer requests for natural moisturizing solutions. Just as importantly, oleosin proteins and phospholipids within safflower oleosomes facilitate efficient emulsification of formulas, without contributing to transepidermal water loss (TEWL) on the surface of the skin.

In a poll of 200 consumers, well over half of all respondents said skin feel is a significant consideration when purchasing a sunscreen product.





Skin-friendly Attributes of CapSol™ Sunscreen Oleosomes

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|---------------------|--|
| INCI Name | <i>Carthamus Tinctorius</i> (Safflower) Oleosomes (and) <i>Carthamus Tinctorius</i> (Safflower) Seedcake Extract |
| Appearance | Off-white cream |
| Odor | Slight, characteristic |
| pH | 4.0 - 5.0 |
| HLB | 5 - 15 functional range, 8 - 13 optimal range |
| Viscosity | 500-2400 cps (DVE Viscometer, LV-3 @ 5.0 rpm) for 30 seconds @ Room Temperature |
| Oleosome % | 65% |
| Preservation System | Gluconolactone (and) Sodium Benzoate |
| Use Levels | 5 - 20% |
| CapSol™ : Oil Ratio | 1:3 |
| Function | Emulsifier, emollient, UV encapsulation and delivery system |
| Main Applications | Skincare, sun care, and color cosmetics |

Simple Yet Elegant Sunscreen-containing Formulations

Now you can produce multifunctional, sunscreen-containing products more efficiently, with a cleaner label, using fewer ingredients. A case in point is seen with the CapSol™ SPF 30 demonstration formula. Using 80% water, 11.7% of CapSol™ oleosomes, 4.7% organic actives and a minimum of humectant and thickener, it is possible to produce elegant formulations for discerning consumers.

In formulations that may otherwise contain synthetic rheology modifiers or synthetic emulsifiers or emollients, CapSol™ oleosomes may significantly improve and often replace the synthetic ingredients. Just as importantly, adding CapSol™ oleosomes to formulations containing synthetic ingredients can bring added benefits, such as moisturization, hydration, barrier protection, and textural improvements, which synthetic ingredients are unable to provide.

Find out how CapSol™ technology brings extra performance and functionality to consumers. Contact us for new ideas in globally compliant product concepts and the data you require to go to market.

CapSol™ Formulary Facts

- Mix well before use or sampling and store raw material between 4°C - 24°C.
- Blend dissolved sun care actives into CapSol™ with a sweep mixer at 400 rpm for 20 to 30 minutes before adding into primary emulsion. This allows actives to equilibrate with the CapSol oleosomes prior to final formulating.
- For optimal emulsion stability, when using oleosomes as a primary emulsifier, include thickeners to ensure viscosity of the finished formulation is over 9000 CPS.
- The raw material can be mixed up to 400 rpm as is and can be mixed up to 800 rpm with a propeller when adding oil phase ingredients to concentrated oleosomes. During emulsification, the mixture can be homogenized up to 3000 rpm.
- Temperatures up to 60°C are acceptable for all CapSol™ formulations. If formulations require temperatures over 60°C, CapSol™ should be added on cool-down. (Do not exceed 70°C.)
- CapSol™ is stable in freeze/thaw cycles in formulations; however, the raw material should never be frozen.
- Formulate at pH between 3.5 - 9.0.
- CapSol™ is compatible with high alcohol systems, but will not result a clear formula.
- CapSol™ is compatible with high salt systems, but will not result in a clear formula.
- CapSol™ is compatible with most preservative systems (avoid protein cross-linkers - e.g. DMDM hydantoin).
- CapSol™ can be loaded with up to 30% its weight in oil-soluble actives and can solubilize water-soluble actives in traditionally anhydrous formulations.
- A modified UV absorbance testing method is recommended (described in the paper by Yang SI., et. al., J. Cosmet Dermatol (2017) www.ncbi.nlm.nih.gov/pubmed/28834040) to conduct accurate *in vitro* measurements that closely correlate to clinical SPF measurements.

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