

LIPOSOL: Liposome-Based Sunscreen

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Motivation/Impact

Motivation

15 minutes

Time it takes for traditional chemical sunscreens to absorb and start working - leaving users vulnerable during early sun exposure

- Many users apply sunscreen after arriving outdoors, exposing their skin to harmful UV rays during that delay
- Conventional sunscreens are often greasy, leave a white residue, and feel heavy on the skin

Impact

- Our liposome-based sunscreen absorbs in under 3 minutes, dramatically reducing the window of vulnerability and aligning better with real-life behavior
- Controlled release of active ingredients from liposome allows for 4-8 hours of sustained protection, reducing the need for frequent application
- The non-greasy, transparent finish enhances wearability, making sun protection more appealing and accessible

Product Specifications

Phase	INCI	% w/w	Function
Liposomal Phase	Lecithin	8	Forms liposome bilayer, stabilizes chemical UV filters
	Ethanol	1	Solvent for lipid dissolution
	Cholesterol	2	Strengthens liposomal membrane, controls release
	Tocopherol	0.3	Antioxidant, protects lipids from oxidation
Oil Phase	Propylene Glycol	5	Humectant, improves liposome stability
	HEPES	2	pH stabilizer, maintains lipid bilayer integrity
	ZnO, Caprylic/Capric Triglyceride	10	UVB/UVA broad-spectrum protection
	Ethylhexyl Methoxycinnamate	7.5	UVB filter, encapsulated in liposomes for stability
	Ethylhexyl Salicylate	5	UVB booster, stabilizes formulation
	Caprylic/Capric Triglyceride	3	Lightweight emollient, improves texture
Water Phase	Poly sorbate 80	0.3	Surfactant, disperses ZnO/TiO ₂ , prevents clumping, supports O/W emulsification
	Aqua	Balance	Solvent
	TiO ₂ , Silica, Alumina	5	UVB + short UVA protection, minimizes whitening
	Disodium EDTA	0.1	Chelating agent, improves stability
Preservatives & Texture Enhancers	Glycerin	4	Humectant, prevents water loss
	Xanthan Gum	0.3	Thickener, prevents settling
	Carbomer	0.3	Gel stabilizer, improves suspension
	Triethanolamine	0.5	Neutralizes Carbomer
	Phenoxyethanol	0.7	Preservative
	Ethylhexylglycerin	0.4	Preservative booster
	Niacinamide	0.8	Anti-inflammatory, brightening agent
	Panthenol	1	Skin soothing, barrier repair
	Allantoin	0.5	Skin protectant, reduces irritation
	Silica	1.5	UV filter stabilizer, minimizes settling, Pre-mixed in ZnO/TiO ₂ dispersions

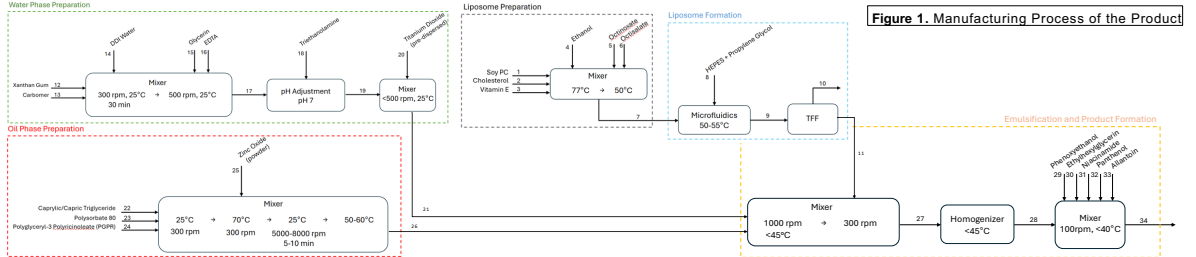
SPF Calculation

Ingredient	Percentage in formulation	Approximate SPF Contribution per 1%	Total SPF contribution
Zinc Oxide	10.00	1.6	16
Titanium Oxide	5.00	2.6	13
Octisalate	5.00	1.5	7.5
Octinoxate	7.50	1.5	11.25
Total			47.75

What makes our product unique?

- Lecithin-based liposomal delivery system of approved UV filters
- Absorbs within 3 minutes and controlled release maintains activity for 4-8 hours
- Improved water & sweat resistance
- Minimizes greasy feel, opens door for added benefits

Manufacturing Process

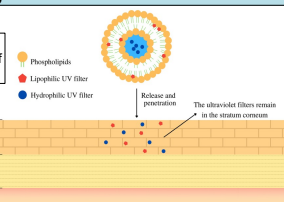


Final Product Design



Process Modeling

Figure 3. Mechanism of liposomal delivery of chemical blockers.



I. Diffusion Mechanism

$$[1] \quad \frac{dC_{\text{lipso}}(t)}{dt} = -k_r C_{\text{lipso}}(t) \quad [2] \quad \frac{\partial C(x,t)}{\partial t} = D_{\text{SC}} \frac{\partial^2 C(x,t)}{\partial x^2}, \quad 0 < x < L, t > 0$$

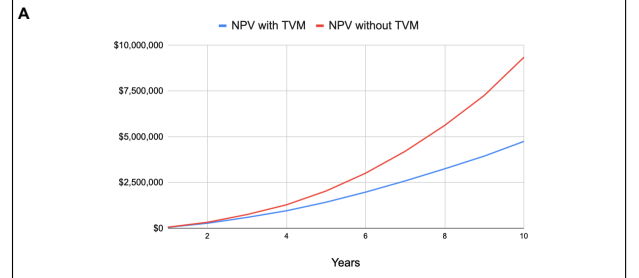
- $C(x,t)$: Drug concentration in the SC (mg/cm^3).
- D_{SC} : Diffusion coefficient of the drug in the SC (cm^2/s).
- k_r : First-order release rate constant from liposomes (s^{-1}).
- $C_{\text{lipso}}(t)$: Drug concentration in the liposome (mg/cm^3).
- K_a : Partition coefficient.

II. Self-Assembly and CMC

$$[1] \quad X_N = N \left[x_1 \exp \left(\frac{\mu_1 - \mu_N}{kT} \right) \right] \quad [2] \quad X \leq \frac{N}{K^{1/N}} = \text{CMC}$$

- X_N : Number of aggregates of size N .
- x_1 : Concentration of free monomers.
- μ_1 : Chemical potential of monomer state.
- μ_N : Chemical potential of aggregate state of size N .
- k : Boltzmann's constant.
- T : Temperature in Kelvin.

Financial Analysis



B Wholesale to retailers for \$15/tube (3 fl oz)

Costs

- Contract manufacturing with SBLC
- R&D: \$58,000 for development
- Operating: \$7 per unit + transport
- Invest 25% of revenue into marketing

Assumptions

- 80% of sunscreen sales are in spring and summer
- Shipping costs 4% revenue
- Social media marketing costs based on number of units sold

Figure 4. A shows the net present value over the first ten years presented with and without adjusting for the time value of money. B displays the main costs and assumptions associated with LipoSol.

Additional Questions?

If you're interested in learning more, check out our works cited using the QR code. Feel free to contact us using the provided contact info!



References



Contact Info