

Design of cosmeceutical products

Design of Cosmeceutical Products: Sun Protection

- Sun protection products are designed to protect the skin from harmful effects of ultraviolet (UV) radiation.
- These products are an important category of **cosmeceuticals**, as they not only improve appearance but also prevent skin damage and disease.

Types of UV radiation affecting skin



UV-A



UV-B



UV-C

1. UV-A (320–400 nm)

- Penetrates deep into the skin (dermis)
- **Causes:**
 - Premature aging (photoaging)
 - Wrinkles
 - Pigmentation
- Present throughout the day and year

2. UV-B (290–320 nm)

- Affects outer skin layer (epidermis)
- **Causes:**
 - Sunburn
 - DNA damage
 - Skin cancer

3. UV-C (100–290 nm)

- Absorbed by ozone layer
- Does not reach earth surface

Effects of UV radiation on skin

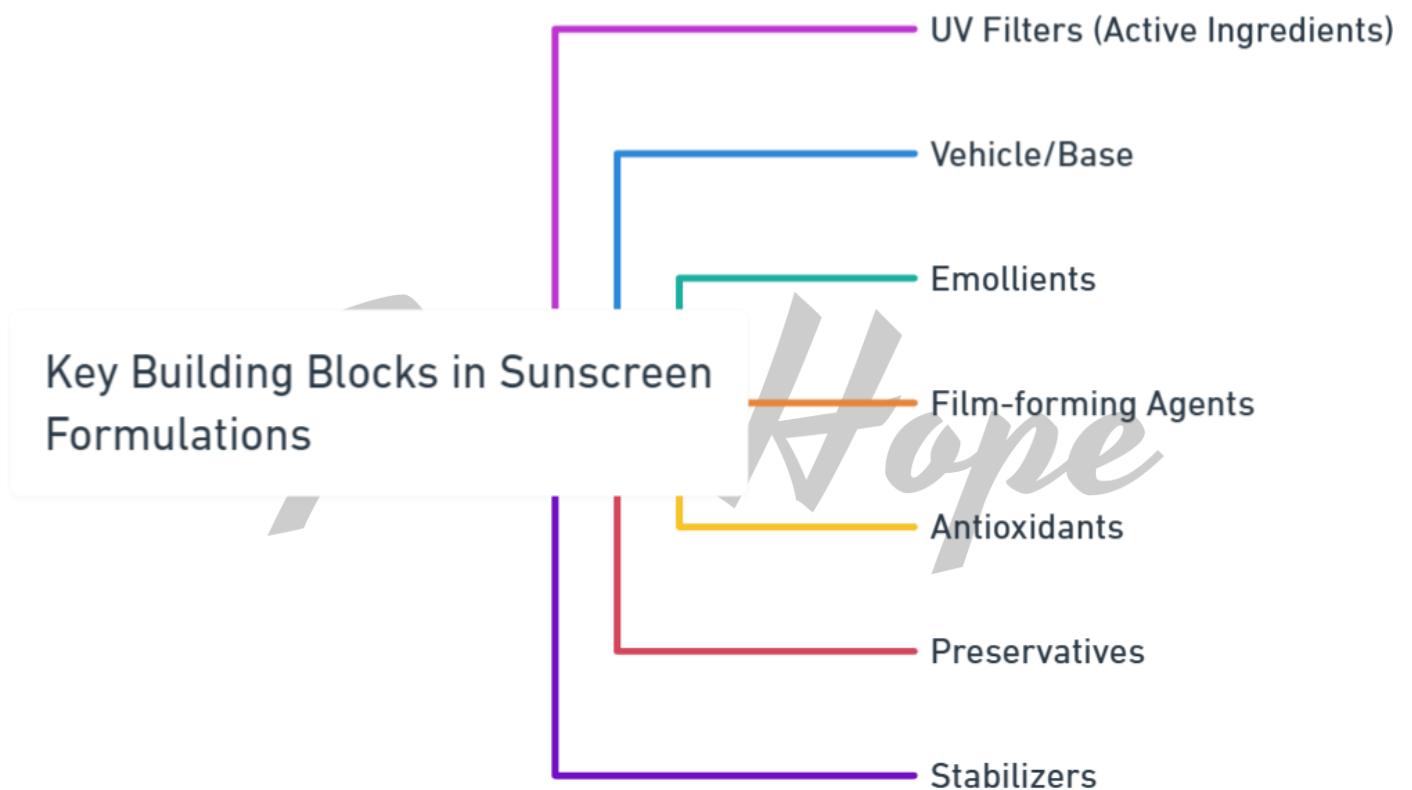
- Sunburn (erythema)

- Tanning and pigmentation
- Premature aging (wrinkles, loss of elasticity)
- DNA damage → risk of skin cancer

Objectives of sun protection formulations

- Block or absorb UV radiation
- Prevent sunburn and tanning
- Reduce long-term skin damage
- Maintain skin health and appearance

Key building blocks in sunscreen formulations



1. UV filters (active ingredients)

- Main protective agents
- Can absorb or reflect UV rays

2. Vehicle/base

- Cream, lotion, gel, spray
- Affects spreadability and user acceptance

3. Emollients

- Improve skin feel and hydration

4. Film-forming agents

- Ensure even coating on skin

- Improve water resistance

5. Antioxidants

- Examples: Vitamin C, Vitamin E
- Reduce free radical damage

6. Preservatives

- Prevent microbial growth

7. Stabilizers

- Prevent degradation of UV filters

Sunscreens: Classification

- Sunscreens are substances that protect skin by either **absorbing** or **reflecting/scattering** UV radiation.



Based on mechanism of action

1. Chemical sunscreens (Organic filters)

Mechanism

- Absorb UV radiation
- Convert it into less harmful energy (heat)

Examples

- Avobenzene (UVA absorber)
- Octinoxate (UVB absorber)
- Oxybenzone

Advantages

- Lightweight and transparent
- Easy to apply
- Good cosmetic acceptability

Disadvantages

- May cause skin irritation or allergy
- Can degrade in sunlight (photoinstability)

2. Physical sunscreens (Inorganic filters)

Mechanism

- Reflect and scatter UV radiation

Examples

- Titanium dioxide
- Zinc oxide

Advantages

- Broad-spectrum protection (UVA + UVB)
- Less irritation (suitable for sensitive skin)
- Photostable

Disadvantages

- Can leave white cast on skin
- Thicker formulations

Based on spectrum of protection

1. UVB sunscreens

- Protect mainly against sunburn
- Example: PABA derivatives

2. UVA sunscreens

- Protect against aging and deep skin damage
- Example: Avobenzone

3. Broad-spectrum sunscreens

- Protect against both UVA and UVB
- Preferred in modern formulations

Based on Sun Protection Factor (SPF)

- **SPF definition**
 - Measure of protection against UVB radiation

Classification

1. **Low protection:** SPF 6–10
2. **Medium protection:** SPF 15–25
3. **High protection:** SPF 30–50
4. **Very high protection:** SPF 50+

Important note

- Higher SPF does not mean complete protection
- **Example:**
 - SPF 30 blocks ~97% UVB
 - SPF 50 blocks ~98–99%

Regulatory Aspects of Sunscreens

- Sunscreens are regulated to ensure safety, efficacy, and proper labeling.
- Regulations vary by region (EU, US, India, etc.).

Classification as cosmetic or drug

- **USA (FDA):**
 - Sunscreens are classified as **OTC drugs**
- **EU:**
 - Classified as **cosmetics**

Approved UV filters

- Only specific UV filters are allowed
- **Each has:**
 - Maximum permitted concentration
- **Example:**
 - Zinc oxide, titanium dioxide (physical filters)
 - Avobenzone, octinoxate (chemical filters)

Labeling requirements

- **Must include:**
 - SPF value



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