

Hydrolyzed Jojoba Esters Improves Water Resistance of Sunscreen Formulas

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Abstract

Hydrolyzed Jojoba Esters (HJE)¹ is a botanically-derived cosmetic/personal care ingredient that has previously demonstrated its ability to act as a fixative within various finished product applications. The present research further explores its fixative potential by evaluating the water resistance properties imparted by HJE when incorporated into a sunscreen. A sunscreen formula (active: 7.5% titanium dioxide), with and without 5% HJE, was evaluated for static and 40-minute water immersion SPF (n=3) in accordance with US FDA Final Rule, 21 CFR Parts 201 and 310. The results show that after 40 minutes of water immersion, the sunscreen formula containing 5% HJE had a 28% higher SPF and maintained an SPF rating of 15 (which was not observed in the formula without HJE). In addition to this property, HJE increases skin hydration when used with glycerin and enhances consumer skin feel, making it a multifunctional ingredient for sun care applications.

Sunscreen Formula

Table 1. Sunscreen Formula	
Ingredient Name	% wt./wt.
Water	65.40
C12-15 Alkyl Benzoate	8.00
Titanium Dioxide (and) Dimethicone	7.50
Floramac 10 [INCI: Ethyl Macadamiate]	5.00
Potassium Cetyl Phosphate	3.00
Sunflower Seed Oil Sorbitol Esters	2.00
Polyhydroxystearic Acid	1.00
Cetearyl Alcohol	1.00
Glycerin	1.00
Floraesters K-20W Jojoba [INCI: Hydrolyzed Jojoba Esters (and) Water (Aqua)]	5.00 ¹
Phenoxyethanol (and) Methylparaben (and) Ethylparaben (and) Butylparaben (and) Propylparaben (and) Isobutylparaben	0.80
Triethanolamine	0.20 ²
Acrylates/C10-30 Alkyl Acrylate Crosspolymer	0.10
Total	100.00

Formulation Benefits of Floraesters K-20W Jojoba

- Rich emolliency that remains after rinse-off
- Substantivity
- Water resistant
- Soluble in most alcohols and glycols
- Dispersible in glycerin
- Allows for oil-free claims
- Botanically derived
- Skin hydration synergy with glycerin
- Readily biodegradable
- Enhances barrier recovery
- Reduces erythema

Improved Water Resistance

Objective:

Determine the water resistance potential between a sunscreen with and without Floraesters K-20W Jojoba.

Design:

The Minimum Erythema Dose (MED) is the lowest UV dose required to produce perceptible erythema. The MED for each subject was measured and used to determine the proper UV exposure during testing of the sunscreen formulas. The static SPF value was calculated using the MED of sunscreen protected skin (MEDp) relative to the MED of unprotected skin (MEDu) on each subject using the following equation: MEDp/MEDu. For the 40-minute immersion test, subjects sat with the testing site submerged in a water bath for two 20-minute immersion periods prior to UV exposure, and SPF was calculated in the same manner as above.³

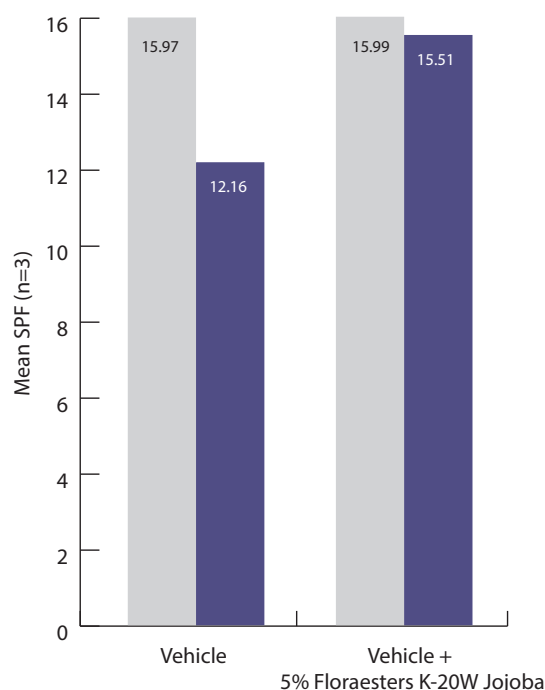
Subjects:

n = 3 (male and female)

Results:

After 40 minutes of water immersion, the sunscreen formula containing 5% Floraesters K-20W Jojoba had a 28% higher SPF and maintained an SPF rating of 15 (which was not seen in the vehicle formula). (Figure 1)

Figure 1. Static and 40-Minute Water Immersion SPF



Static SPF
40-min Water Immersion SPF

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Improved Skin Hydration

Objective:

Determine the skin hydration potential between a sunscreen with and without Floraesters K-20W Jojoba.

Design:

One application of each test article was made to the outer leg of subjects with dry legs. Skin hydration measurements (via Corneometer CM 825⁴) were taken at baseline, and one and two hours post-test article application.

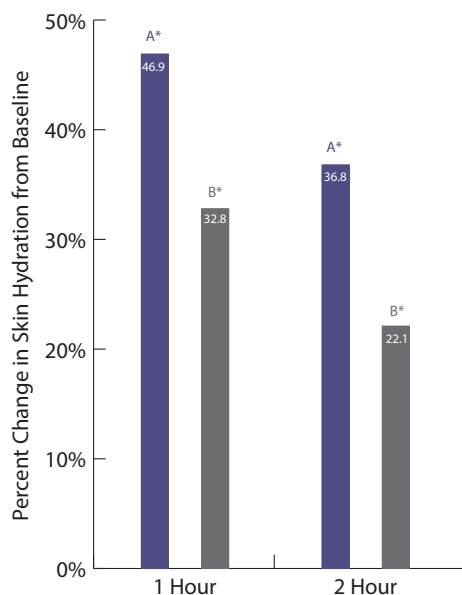
Subjects:

n = 17 (female)

Results:

The sunscreen formula containing 5% Floraesters K-20W Jojoba increased skin hydration statistically significantly ($p < 0.05$) more than the formula without, one and two hours post-test article application (14% and 15% more, respectively). (Figure 2)

Figure 2. Skin Hydration



■ A - Vehicle + 5% Floraesters K-20W Jojoba
 ■ B - Vehicle

*Statistically significant increase ($p < 0.05$) from baseline.

Conclusions

- Incorporating Floraesters K-20W Jojoba within a sunscreen formula resulted in improved SPF following 40-minute water immersion.
- Floraesters K-20W Jojoba increased skin hydration within a sunscreen formula.
- Floramac 10 enhances dispersion on titanium dioxide.

Improved TiO₂ Dispersion with Floramac 10

Objective:

A comparison of Floramac 10 (Mac 10) and isopropyl myristate (IPM) to minimize quantity and size of titanium dioxide (7.5%) particles [with and without a dispersing agent⁵ (DA)].

Design:

One application (0.2ml) of each test article was made to the Fineness of Grind Gage.⁶ The sample was then scraped across the gage and particle quantity (by size) was determined by counting undispersed particles.

Results:

The sunscreen formula containing 5% Floramac 10 resulted in fewer and smaller undispersed titanium dioxide particles than the formula with IPM. (Table 2 and Figure 3) Additionally, the sunscreen formula containing 5% Floramac 10 resulted in a more uniform dispersion. (Figure 4)

Table 2. Dispersion of Titanium Dioxide

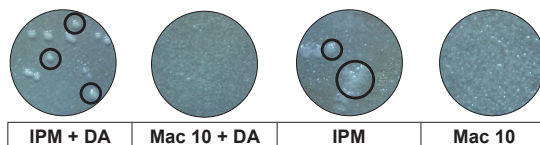
Particle Size Microns (μ)	Average Undispersed-Particle Count (% of total)			
	with DA		without DA	
	Mac 10	IPM	Mac 10	IPM
76.2 - 101.6 μ	74 (26%)	108 (36%)	3 (5%)	477 (35%)
50.8 - 76.2 μ	87 (31%)	108 (36%)	7 (15%)	522 (39%)
25.4 - 50.8 μ	97 (34%)	62 (21%)	14 (30%)	303 (22%)
<25.4 μ	24 (9%)	20 (7%)	23 (50%)	48 (4%)
Total	282	298	46	1350



Figure 3. Scrape Image

Note the uniform dispersion of the titanium dioxide in the scrape of the sunscreen formula with Floramac 10 versus isopropyl myristate.

Figure 4. Microscope Images of Scrape (60x)



Note the undispersed particles (circled) of the titanium dioxide in the microscope images of the sunscreen formula with Floramac 10 versus isopropyl myristate.

Footnotes/References

1. The test material, i.e. Floraesters K-20W Jojoba, is a 20% hydrolyzed jojoba esters dilution in water [INCI: Hydrolyzed Jojoba Esters (and) Water (Aqua)].
2. The test articles included either 5.00% Floraesters K-20W Jojoba or 0.20% Triethanolamine (q.s. deionized water).
3. SPF testing was conducted according to the US FDA Final Rule; 21 CFR Parts 201 and 310 by Suncare Research Laboratories, LLC (Winston Salem, NC).
4. Corneometer CM 825 is a product of Courage + Khazaka (Köln, Germany).
5. The dispersing agent used was Polyhydroxystearic Acid produced by Innospec Performance Chemicals (Salisbury, NC).
6. The Fineness of Grind Gage is a product of Precision Gage & Tool Company (Dayton, OH).

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