

A close-up photograph of a woman's face, splashed with water. Her eyes are closed, and her mouth is wide open in a shout or yell. Water droplets are frozen in mid-air around her face, creating a dynamic and energetic scene. The background is a solid, bright blue color.

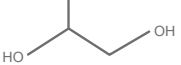

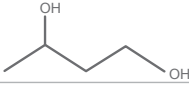
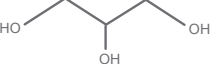
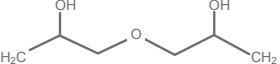
Performance is in our nature.

zemea[®]
bio-based performance

Zemea® Propanediol for Skin Care

Zemea® propanediol is a natural, skin-friendly, preservative-boosting alternative to petroleum-based glycols and glycerin for formulators who desire versatile and innovative cosmetic ingredients.

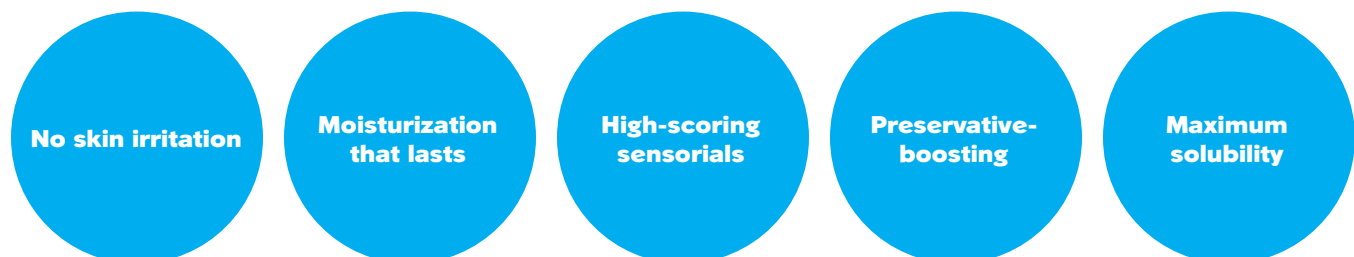
Zemea® propanediol is ideally suited for many different skin and body care applications including moisturizers, cleansers, anti-aging products, sunscreens, anti-acne products, sensitive skin products, deodorant, wipes and baby care.

Common	Ingredient	CAS#	Formula	Structure	MW	BP, °C	MP, °C	Density
Propylene Glycol	1,2-propanediol	57-55-6	C ₃ H ₈ O ₂		76.1	187.3	-60	1.038
Zemea® Propanediol	1,3-propanediol	504-63-2	C ₃ H ₈ O ₂		76.1	214	-24	1.053
Butylene Glycol	1,3-butanediol	107-88-0	C ₄ H ₁₀ O ₂		90.1	204	-50	1.0053
Glycerin	1,2,3-propanediol	504-63-2	C ₃ H ₈ O ₃		92.1	290	18	1.261
DPG	dipropylene glycol	25265-71-8	C ₆ H ₁₄ O ₃		134.17	231		1.023

Zemea® propanediol benefits in skin care formulations

Studies have demonstrated the unique performance benefits of Zemea® propanediol in skin care products.

Pure performance



Reduced skin irritation

In multiple studies using the modified Draize Repeated Insult Patch Test method, Zemea® propanediol produced no skin irritation, fatigue or sensitization—even at high concentrations.¹ Researchers observed no clinically significant dermal irritation or allergic contact following exposure of up to 75% Zemea® propanediol at three different pH levels.

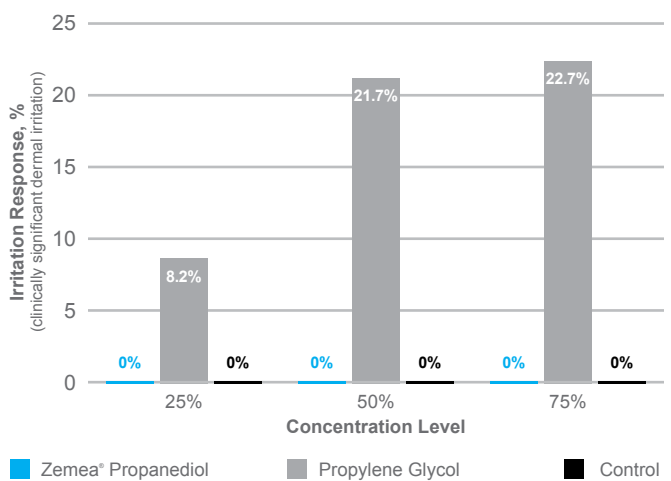
By contrast, skin irritation was observed with propylene glycol (PG) at a concentration of 25%, with nearly one-quarter of the test population indicating positive irritation at a 75% concentration. Results from these studies show that Zemea® propanediol has low potential to irritate or sensitize human skin.

Moisturization performance vs. glycerin

In tests comparing the moisturizing effect of Zemea® propanediol to glycerin at a 10% use level, measurements taken with a Corneometer ASA-M2 showed that Zemea® propanediol provides improved skin moisturization during initial application.² A mixture of 5% Zemea® propanediol/5% glycerin in formulation demonstrated a synergistic effect that improved and extended skin moisturization. Formulating with a Zemea® propanediol/glycerin mixture also requires less glycerin and may reduce tackiness.

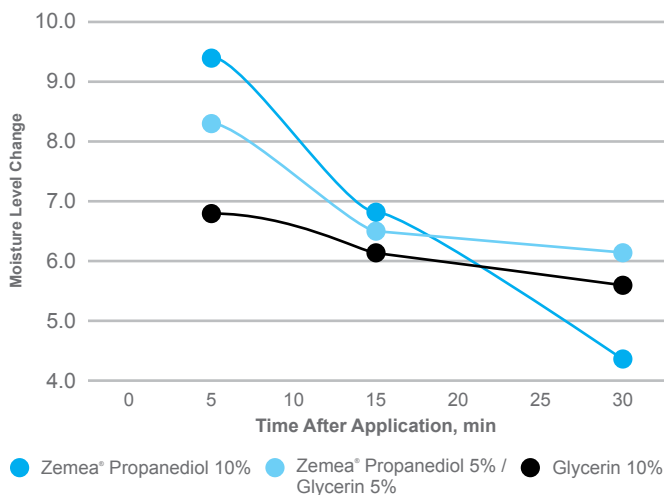
Human Skin Patch Test Results

207 individuals exposed to Zemea® propanediol or Propylene Glycol or Control at 7pH



At concentrations as high as 75%, Zemea® propanediol has not produced skin irritation or sensitization reactions.

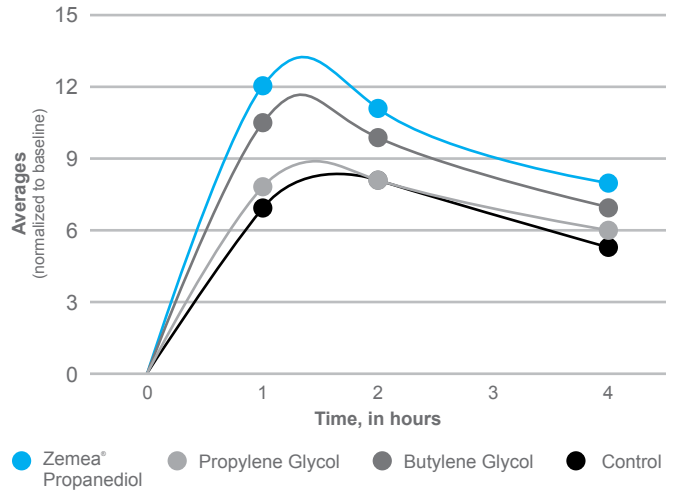
Skin Moisturization Increase Compared to 10% Glycerin



1. DuPont Tate & Lyle Bio Products, Miller, Robert, et al., Evaluation of Bio-Based 1,3-Propanediol as a 100% Natural Glycol Replacement. 2. DuPont Tate & Lyle Bio Products, Technical Bulletin: Zemea® Propanediol: Skin Moisturizing Performance.

Moisturization performance vs. petroleum-based glycols

In two independent tests conducted between Zemea[®] propanediol and petroleum-based glycols, measurements with a Corneometer 825 PC[®] (Courage + Khazaka) revealed that Zemea[®] propanediol was more efficient than either PG or butylene glycol (BG) at moisturizing the skin at a 5% use level.³

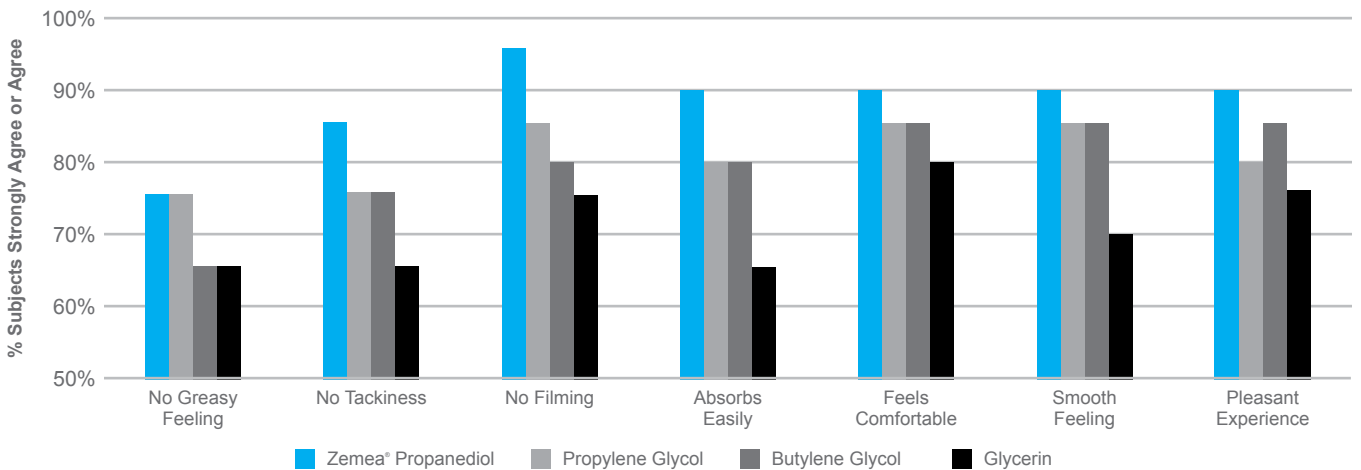


High-scoring sensorials

In repeated consumer sensory studies, lotions formulated with Zemea[®] propanediol rated higher for all sensory attributes than lotions formulated with glycerin. Zemea[®] propanediol is also effective at reducing the tackiness associated with high concentrations of glycerin in certain formulations.⁴

Consumer Sensory Testing

Skin Lotion with 5% glycol



3. DuPont Tate & Lyle Bio Products, Miller, Robert, et al., Evaluation of Bio-Based 1,3-Propanediol as a 100% Natural Glycol Replacement. 4. Ibid.

Preservative-boosting performance

CTFA Preservative Challenge Testing has shown that Zemea® propanediol can boost the efficacy of preservatives in a formulation. Seven different preservatives were tested at 50% of the recommended use level in a skin care

emulsion. The Zemea® propanediol use level was varied from 0-6% to determine the minimum level of Zemea® propanediol needed to pass the challenge test.⁵

Minimum Percentage of Zemea® Propanediol Needed to Boost Preservative Efficacy

Preservatives		Challenge Organisms				
		gram-positive	gram-negative	gram-negative	yeast	mold
		<i>Staphylococcus aureus</i>	<i>Escherichia coli</i>	<i>Pseudomonas aeruginosa</i>	<i>Candida albicans</i>	<i>Aspergillus niger</i>
phenoxylethanol-based	Microcare PM3 (0.15%)	2%	2%	2%	4%	2% (1 log reduction)
	euxyl® PE 9010 (0.25%)	4%	4%	2%	6%	2% (1 log reduction)
	Neolone PE (0.3%)	2%	2%		6%	2% (1 log reduction)
	Jeecide CAP-4 Optiphen (0.25%)	2%	2%		6%	2% (1 log reduction)
natural	Lexgard® Natural (0.5%)	Preservative levels provided sufficient reduction to <1.00 CFU/g without addition of Zemea® propanediol.				2% (1 log reduction)
	Dermosoft 688 ECO (0.1%)	Preservative levels provided sufficient reduction to <1.00 CFU/g without addition of Zemea® propanediol.			2%	2% (1 log reduction)
	Geogard® ULTRA (0.5%)	Preservative levels provided sufficient reduction to <1.00 CFU/g without addition of Zemea® propanediol.			2%	2% (1 log reduction)

Organisms reduced to <1.00 CFU/g at Day 7

Effective solubility

Zemea® propanediol has a unique set of Hansen Solubility Parameters. Software modeling suggested that Zemea® propanediol can be an effective solvent for actives and functional materials in skin care products and sunscreens.⁶

In tests, Zemea® propanediol worked well as a primary solvent to maximize the solubility of ferulic acid and allantoin. Zemea® propanediol worked well as a secondary solvent to manage the solubility and extend delivery time of ascorbic

acid and glycolic acid. Zemea® propanediol worked well as a solvent to optimize formulation design and efficacy for salicylic acid and hexylresorcinol. In a broad-spectrum, daily-wear facial moisturizer, the addition of Zemea® propanediol effectively kept the sunscreen actives ensulizole and sulisobenzone in solution during the evaporative process on the skin, leading to greater efficacy.⁷



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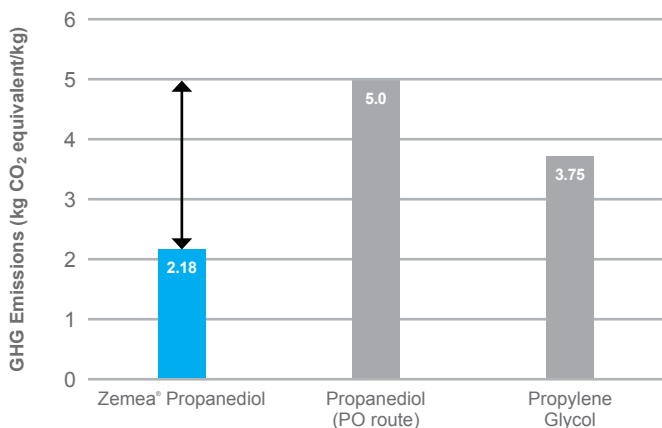
The greener alternative

Zemea® propanediol is produced through a proprietary fermentation process using plant-derived glucose instead of petroleum-based feedstocks. The resulting product is typically 99.99% pure.

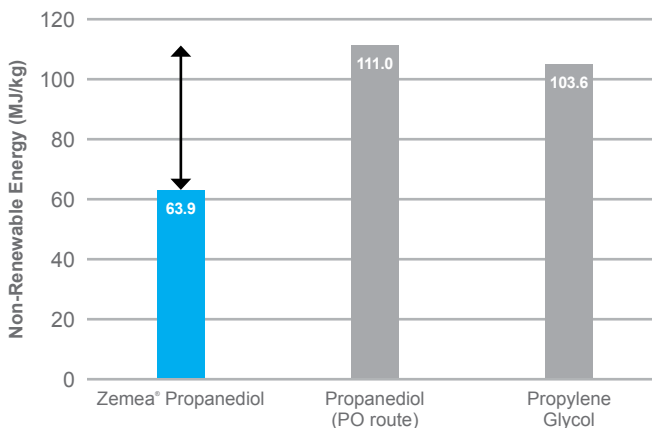
From “cradle-to-gate,” Zemea® propanediol produces 56% less greenhouse gas emissions and consumes 42% less nonrenewable energy than petroleum-based 1,3-propanediol. Compared with PG, Zemea® propanediol

produces 42% less greenhouse gas emissions and uses 38% less nonrenewable energy from cradle-to-gate.⁸

Zemea® propanediol is certified 100% bio-based under the USDA’s BioPreferred® Program and is the world’s first 100% bio-based glycol alternative to have earned certification from the Natural Products Association.



Greenhouse Gas Emissions
56% less than Propanediol
42% less than Propylene Glycol



Non-Renewable Energy Use
42% less than Propanediol
38% less than Propylene Glycol

Zemea® propanediol approvals, certifications and registrations

Approvals/Certifications:

- Natural Products Association (NPA)
- USDA BioPreferred® Program – 100% Bio-based
- Natural Health Products Ingredient – Health Canada
- Complies with ISO 16128-1:2016
- EPA Design for the Environment (DfE)
- GRAS
- Halal
- Kosher
- USP-NF

Registrations:

- INCI Name: Propanediol
- EINECS Number: 207-997-3
- CAS Number: 504-63-2
- REACH Registration Number: 01-2119489383-28-0000

⁸ Zemea® propanediol LCA data based on Loudon process design data; peer reviewed by Five Winds International.

zemea-performs.com

About DuPont Tate & Lyle Bio Products

DuPont Tate & Lyle Bio Products Company, LLC., is a joint venture between DuPont, a global science company, and Tate & Lyle, a world-leading renewable food and industrial ingredients company. DuPont Tate & Lyle Bio Products provides natural and renewably sourced ingredients that enhance product performance. We offer solutions for a wide variety of markets and applications through our bio-based performance brands, Susterra® and Zemea®. For more information, visit www.duponttateandlyle.com

