



TECHNICAL BULLETIN

Zemea® Propanediol: Consumer Sensory and Moisturization Study

Introduction

The objective of this study was to determine if Zemea® propanediol could improve consumer sensory perceptions of a typical high moisturizing lotion based on glycerin while maintaining satisfactory humectancy performance. The generic lotion containing 20 wt. % glycerin was compared to both a lotion with 20 wt. % Zemea® propanediol, and a lotion using a blend of Zemea® propanediol / glycerin (10 wt. % each). This study used Corneometer® assessments of skin hydration and consumer sensory evaluations. The subjects of the study were 6 male and 23 female healthy volunteers between the ages of 19 and 66 who use moisturizing lotion on a daily basis. The study was conducted by Princeton Consumer Research, Princeton, NJ, USA on behalf of DuPont Tate & Lyle Bio Products Company, LLC.

Background

Previous studies have been conducted to evaluate the moisturization efficacy and consumer sensory perceptions of various formulations containing Zemea® propanediol, glycerin and/or other diols:

In 2008, a study was conducted to measure the moisturizing performance of o/w skin care emulsions with 5 wt. % varying humectant that included Zemea® propanediol, propylene glycol (PG), butylene glycol (BG) and a control (water). Each test cream was applied on the forearms of 10 subjects. A Corneometer® CM 825 (Courage & Khazaka) was used to measure skin moisturization over a 4 hour time period. Zemea® propanediol was found to be more efficient in moisturizing the skin throughout the entire testing period.

In 2009, a consumer sensory study was conducted to measure the sensory perceptions of o/w lotions formulated with 5 wt. % varying humectant that included Zemea® propanediol, glycerin, PG and BG. This was a blind test with four-day conditioning and three-day product use cycle. Twenty subjects completed a daily use questionnaire to report their level of agreement on a scale of 1 to 7 with 10 different statements regarding each lotion's sensory and use characteristics. The lotion formulated with Zemea® propanediol was rated higher or equivalent than the lotion containing glycerin on all 10 sensory attributes and was rated higher or equivalent to the lotions containing PG and BG.

In the current study, we evaluated the moisturization values and consumer sensory perceptions of three high moisturizing formulations that contained either:

- Zemea® Propanediol (20 wt.%)
- Glycerin (20 wt.%)
- Zemea® Propanediol / glycerin mixture (10 wt.% each)

This was a blind, randomized test with a three-day washout phase for the Corneometer® component of the study.

Experimental Design

A. Formulation

Brand Name	INCI Name	Manufacturer	Wt. %
Eastman Gem	Ethylhexyl Palmitate	Eastman	5.0%
Lipex Shealight	Shea Butter Ethyl Esters	AAK	5.0%
Water	Aqua		65.0%
Arlacel LC	Sorbitan Stearate (and) Sorbityl Laurate	Croda	4.0%
Zemea® Propanediol	Propanediol	DuPont Tate & Lyle	20.0%
Ultrapure Xanthan Gum NF	Xanthan Gum	Ultra	0.1%
Germaben II	Propylene Glycol (and) Diazolidinyl Urea (and) Methyl Paraben (and) Propyl Paraben	Ashland	0.9%

Table 1. High Moisturizing Zemea® Propanediol Formulation

(Table 1) shows the formulation used for this study containing 20 wt. % Zemea® propanediol. The other two high moisturizing formulations tested were identical to the Zemea® propanediol formulation above except for the humectant component as previously mentioned. The test formulations were manufactured and supplied by ACT Solutions Corp., Newark, Delaware, USA.

B. Corneometer® Assessments of Skin Hydration

Washout Phase: Subjects were provided with a bland soap product to use on their lower legs for days 1, 2 and 3 prior to the active phase. They were instructed not to use any other treatment products on their lower legs for the duration of the study. These products include moisturizing foam baths, shower gels or soaps, lotions and creams, and depilatory products.

Pre-treatment: On day 4, subjects were instructed to not wash their lower legs for three hours prior to returning to the test center. Upon arrival at the test center, subjects rested for a period of at least 30 minutes in a controlled environment at a temperature of 72°F + 4°F and at a relative humidity of 45% + 5%. Following the rest period the lower legs were marked with a total of five 5cm x 5cm squares using a gentian violet skin marker pen. Prior to application of the test formulations, three baseline readings were made at each site using the Corneometer® CM 825 (Courage and Khazaka, Germany).

Active Phase: The subjects remained in the controlled temperature and humidity environment for the 1 hour and 4 hour assessments. A single application of each of the test formulations was applied to each subject's lower leg. One site remained untreated (negative control) and another site was dosed with 100% glycerin (positive control). The test formulations and control were applied randomly among the subjects. Corneometer® assessments of skin hydration were conducted at 1 hour, 4 hours, and 24 hours following application of the test formulations. Prior to the 24 hour Corneometer® assessment, subjects again rested for a period of at least 30 minutes in a controlled temperature and humidity environment.

C. Consumer Sensory Perception

This was a blind, randomized test with a three-day product use cycle. Subjects visited the test center on day 1 of the study and three 3cm x 3cm squares were marked on the subjects' volar forearms in indelible skin marker. A qualified technician then made a single application of each of the test formulations to the marked areas. The subjects returned to the test center on days 2 and 3 for additional applications of each of the test formulations to the marked areas. On day 3 of the study, immediately following each product's final application, the subjects completed questionnaires to report their level of agreement on a scale of 1 to 7 with 10 different statements regarding each test formulation's sensory and use characteristics.

Results

A. Corneometer® Assessments of Skin Hydration

The mean Corneometer® measurements for moisturization are presented in (Table 2) and (Figure 1). Baseline measurements demonstrated that there were no statistically significant differences between the test sites and the untreated site prior to application of the test formulations, confirming the validity of the study.

Test Formulation	Mean Corneometer® Measurements			
	Baseline	1 Hour	4 Hours	24 Hours
High Moisturizing Zemea® Propanediol	18.0	29.7	28.7	20.5
High Moisturizing Glycerin	17.0	35.8	34.6	25.0
High Moisturizing Zemea® Propanediol / Glycerin	16.1	34.3	33.1	23.1
Glycerin (Positive Control)	16.9	95.7	85.3	75.4
Untreated Site (Negative Control)	17.7	17.6	22.1	19.1

Table 2. Mean Corneometer® Measurements

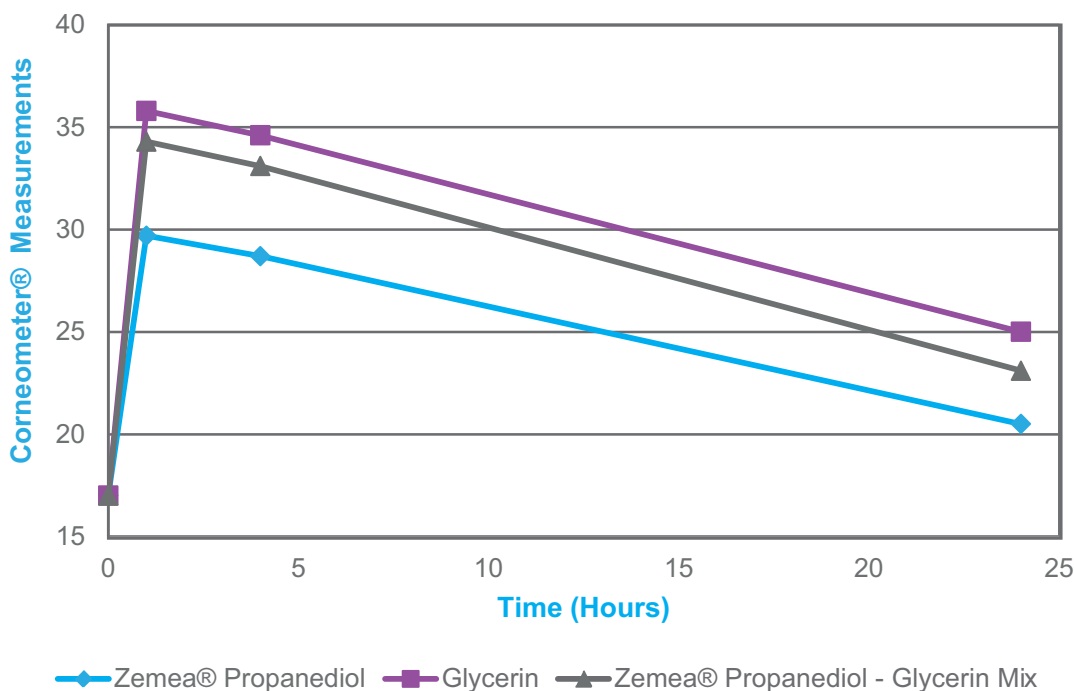


Figure 1. Mean Corneometer® Measurements

All three test formulations produced statistically significant increases in hydration of the skin at the 1 hour and 4 hour assessments compared to the baseline. At the 24 hour assessment, the glycerin and the Zemea® propanediol / glycerin mix produced statistically significant increases in hydration. These conclusions are supported by p-Values which are less than 0.05 in (Table 3).

Test Formulation	Between Treatment Comparison			
	Baseline	1 Hour	4 Hours	24 Hours
High Moisturizing Zemea® Propanediol	0.7729	<0.0001	0.0002	0.2795
High Moisturizing Glycerin	0.5854	<0.0001	<0.0001	0.0008
High Moisturizing Zemea® Propanediol / Glycerin	0.1052	<0.0001	<0.0001	0.0069
Glycerin (Positive Control)	0.5242	<0.0001	<0.0001	<0.0001
Untreated Site (Negative Control)	N/A	N/A	N/A	N/A

Table 3. Treated Areas Compared to Baseline (p-Values <0.05; 95% Confidence Level)

The glycerin and the Zemea® propanediol / glycerin mix showed statistical differences in skin hydration vs. Zemea® propanediol. No statistical differences in skin hydration were observed between glycerin and the Zemea® propanediol / glycerin mix at any time-points. These conclusions are supported by p-Values which are less than 0.05 in (Table 4).

Test Formulation	Between Treatment Comparison		
	1 Hour	4 Hours	24 Hours
Zemea® Propanediol vs. Glycerin	0.0014	0.0089	0.0033
Zemea® Propanediol vs. Zemea® Propanediol / Glycerin Mix	0.0043	0.0240	0.0393
Glycerin vs. Zemea® Propanediol / Glycerin Mix	0.3009	0.3391	0.1298

Table 4. Test Formulations Compared to Baseline (p-Values <0.05; 95% Confidence Level)

B. Consumer Sensory Perception

Consumer sensory ratings for the lotion containing Zemea® propanediol were higher on all of the attributes than the lotions containing glycerin and the Zemea® propanediol / glycerin mix. Eight out of the ten attributes, listed in (Table 5), were rated more favorably for the Zemea® propanediol / glycerin mix vs. glycerin. The mean Consumer Sensory ratings for all three test formulations are shown on the following page in (Figure 2).

Spreads easily when I apply it on my skin	Skin feels moisturized after using
Has a smooth feel as I apply it on my skin	Leaves a soft feeling on the skin
Does not feel tacky or sticky after application	Does not form a film on the skin
Had a pleasant experience using it	Absorbs into my skin

Table 5. Attributes Rated More Favorably for Zemea® Propanediol / Glycerin Mix vs. Glycerin

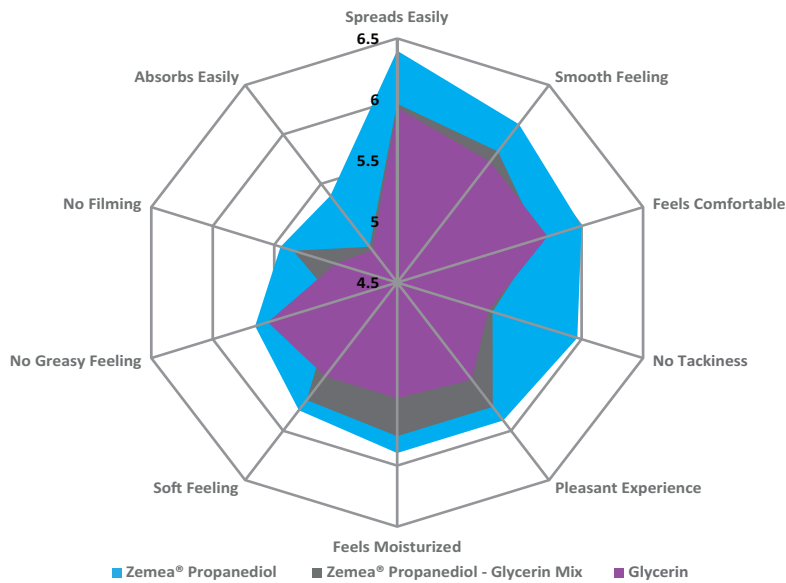


Figure 2. Mean Consumer Sensory Ratings

Conclusions

- In repeated consumer sensory studies, lotions formulated with Zemea® propanediol are rated higher on all sensory attributes than lotions formulated with glycerin.
- Zemea® propanediol provides good skin hydration results when used in a formulation at both a 5% concentration as well as a higher concentration level of 20%.
- The addition of Zemea® propanediol to glycerin-based formulations can improve the consumer perceived aesthetics without compromising hydration performance of the formulation.
- All test formulations produced statistically significant increases in hydration of the skin vs. the control for the 1 hour and 4 hour assessments.
- No statistical differences in skin hydration were observed between the glycerin and the Zemea® propanediol / glycerin mix at all time-points.
- Even at 24 hours, the Zemea® propanediol / glycerin mix and the glycerin formulations were statistically the same in hydration.

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