Personal Care Humectants

Dennis Abbeduto, Personal Care Product Manager
WASH YOUR HANDS

PREVENT ILLNESS BY WASHING YOUR HANDS!

1. Wet your hands
2. Apply soap
3. Lather & scrub (20 secs)
4. Rinse (10 secs)
5. Turn off tap
6. Dry your hands
7. Open door with paper towel

DON'T FORGET TO WASH:
- between your fingers
- under your nails
- tops of your hands

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Outline

• Emollient vs Occlusive vs Humectant
• Humectant Examples
• Building a Better Humectant
  - Chemistry
  - Product Safety
• Moisturization Efficacy
  - In-vitro
  - In-vivo
    • Leave on
    • Rinse off
• Additional Application Data
THE CHEMISTRY OF MOISTURISERS

Whether you’re suffering from sunburn in the summer, or dry skin in the winter, moisturisers are on hand to help. This graphic takes a look at some of the different compounds that moisturisers combine, and how each of the groups of compounds act to help produce a moisturising effect.

Skin & Water Loss

TEWL

Epidermis

Dermis

Hypodermis

The skin has 3 main layers. The middle layer, the dermis, has several roles which include storing water. Transdermal water loss (TEWL) is a normal process of water loss through the epidermis; moisturisers aim to reduce this water loss.

The Epidermis

Ceramides

Fatty Acid

Cholesterol

The epidermis is composed of five sub-layers. The uppermost of these is the stratum corneum, which is made up of dead skin cells surrounded by proteins. Ceramides, fatty acids and cholesterol fill the gaps between cells, limiting transdermal water loss.

Emollients

Like occlusives, emollients can form a barrier to TEWL, when applied heavily. They can also reduce TEWL by helping ‘plug’ the gaps between corneocytes (dead skin cells), replacing absent natural skin lipids, and help smooth roughened skin.

Humectants

Glycerin (L) & Sorbitol (R)

Other humectants include urea, sodium lactate, & hyaluronic acid.

Occlusives

Petrolatum

Occlusive agents prevent water loss by forming a hydrophobic barrier over the stratum corneum (the upper layer of the epidermis). Vaseline is an example of an occlusive moisturiser. Though effective, they make skin feel greasy.
Skin & Water Loss

The skin has 3 main layers. The middle layer, the dermis, has several roles which include storing water. Transepidermal water loss (TEWL) is a normal process of water loss through the epidermis; moisturisers aim to reduce this water loss.
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Occlusives

- **Occlusive agents** prevent water loss by forming a hydrophobic barrier over the stratum corneum (the upper layer of the epidermis). Vaseline is an example of an occlusive moisturiser. Though effective, they make skin feel greasy.

- **PETROLATUM**: Mixture of hydrocarbons with 25+ carbon atoms. Other occlusives include lanolin & silicones.
Emollients

Like occlusives, emollients can form a barrier to TEWL when applied heavily. They can also reduce TEWL by helping ‘plug’ the gaps between corneocytes (dead skin cells), replacing absent natural skin lipids, and help smooth roughened skin.

**GLYCOL STEARATE (L) & CHOLESTEROL (R)**

Others: ceramides, squalene, & fatty acids.
Humectants are hydrophilic, and help draw water from the dermis to the epidermis. At humidity higher than 80%, they can also draw water from the atmosphere. Evaporation from skin as a result can also cause extra dryness, however.
NMF Components

- Free amino acids and urocanic acid
- Lactate
- Urea
- Sodium
- Calcium
- Ammonia, creatine, uric acid, glucosamine
- Pyrrolidone carboxylic acid (PCA)
- Sugars, organic acids, peptides, etc.
- Chloride
- Potassium
- Magnesium
- Phosphate
The Workhorse - Glycerin

• Pros
  - Low Cost
  - Efficient water binding
  - High skin compatibility

• Cons
  - Tackiness
  - No substantivity
Other Common Humectants

• Glycols
  - Propylene Glycol
  - Dipropylene Glycol
  - Pentylene Glycol

• Sugar alcohols
  - Mannitol
  - Sorbitol
  - Xylitol

• Polyols/Polysaccharides
  - Maltitol
  - Cellulose
  - Galactoglucoarabinomannan

• Hydroxy acids
  - Lactic Acid
  - Glycolic Acid
  - Tartaric Acid
Nature-Inspired Improvements

- **Urea**
  - An important endogenous NMF component
  - Has limited water binding efficiency

- Potential to improve by adding more water binding sites

- Urea + MEA = Hydroxyethyl Urea (+NH₃)

- Improved moisturization but…
  - pH instability
  - Trace DEA
Other Nature-Inspired Chemistry

• Small molecules
  - Acetamide MEA
  - Lactamide MEA

• Hybrid Emollient/Emulsifier/Humectants
  - Sorbitan Oleate
  - Polyglyceryl-3 Oleate

• Ethoxylates
  - Methyl Gluceth-20
  - Sorbeth Tetraoleate
New Chemistry – Cola®Moist 200

INCI NAME  Hydroxypropyl Bis-Hydroxyethylidimonium Chloride
CAS NO.    110528-94-4
LISTINGS   TSCA, NDSL, REACH, IECIC

\[
\begin{align*}
\text{CH}_3 & \quad \text{OH} \quad \text{H}_3\text{C} \\
\text{N}^{+} & \quad \text{OH} \quad \text{N}^{+} \\
\text{CH}_3 & \quad \text{OH} \quad \text{Cl}^- \\
\text{HO} & \quad \text{Cl}^-
\end{align*}
\]
Cola®Moist 200 Toxicity Testing

• Eye irritation
  - HET-CAM testing
    • 5% solid solution – Score 2.5 (Non-irritating)
  - MatTek EpiOcular
    • 2% solid solution – ET-50 >256min (Non-irritating)

• Skin irritation
  - 48 hour patch test
    • 5% solid solution – No irritation
  - HRIPT
    • 5% solid solution – No sensitization

• Mutagenicity
  - Ames assay
    • 5% solid - No genotoxic activity
Cola®Moist 200 Moisturization Efficacy

• Water binding test

• Rubine dye test

• Lotion efficacy

• Rinse off efficacy
Cola®Moist 200 Water Binding – Very low humidity

Humectants 10% RH

% Moisture

- ColaMoist 200
- Polyether chloride
- Hydroxyethyl urea
- Glycerin
- Sodium PCA
- Sodium Lactate
Cola®Moist 200 Water Binding – Low humidity

Humectants 30% RH

<table>
<thead>
<tr>
<th>Humectant</th>
<th>% Moisture</th>
</tr>
</thead>
<tbody>
<tr>
<td>ColaMoist 200</td>
<td>13.0%</td>
</tr>
<tr>
<td>Polyether chloride</td>
<td>6.0%</td>
</tr>
<tr>
<td>Hydroxyethyl urea</td>
<td>8.0%</td>
</tr>
<tr>
<td>Glycerin</td>
<td>9.0%</td>
</tr>
<tr>
<td>Sodium PCA</td>
<td>7.0%</td>
</tr>
<tr>
<td>Sodium Lactate</td>
<td>10.0%</td>
</tr>
</tbody>
</table>
Rubine Dye Test

• Background
  - Rubine dye is anionic and adheres strongly to substrates with free cationic charge at the surface
  - Increased dye intensity under identical treatment conditions indicates higher substantivity cationic molecules to the substrate

• Cola®Moist 200 Test
  - 2% solution of Cola®Moist 200 was applied to non-mercerized cotton skein
  - Negative control skein treated with water
  - Skeins were rinsed thoroughly with water before applying rubine dye solution
  - After 30 seconds, the rubine dye solution was rinsed from the skeins with water

• Results
  - Cola®Moist 200 displayed strong dye retention compared to indicating the retention of Cola®Moist 200 on the test substrate.
  - Skeins treated with surfactant solution containing Cola®Moist 200 demonstrated similar substantivity
Rubine Dye Test

Negative Control

Cola®Moist 200 – 2%
Skin Moisturization Study – Leave On

• Background
  - Cola®Moist 200 was compared to a leading glycerin replacement

• Study Design
  - Each test article was added at 5% as supplied to a neutral lotion base
  - 10 healthy skin volunteers
  - Lotion base and lotions containing test articles were applied to each volunteer on volar forearm
  - Skin moisturization measured with Nova DPM 9003 at baseline and 2, 4, 6, 8 hours after application

• Results
  - Cola®Moist 200 significantly improved moisturization over the base lotion and the competitive material throughout the 8-hour study
Skin Moisturization Study – Leave On

![Graph showing percent change over hours for ColaMoist 200, Brand A, and Control.](image)
Skin Moisturization Study – Rinse Off

• Background
  - A sulfate-free body wash was compared to the same body wash containing 3% Cola®Moist 200 (as supplied)

• Study Design
  - 26 healthy, dry skin volunteers (Dryness Score 1.5 – 3.0)
  - LCAT (Lower Leg Controlled Application Test) Design
  - 4 test sites: Placebo control wash, active wash, water control, untreated control
  - Skin moisturization was measured with visual grading and Corneometer® at baseline and 4, 8, 12 hours after application

• Results
  - The sulfate-free body wash with Cola®Moist 200 significantly improved moisturization over all other conditions throughout the 12-hour study
Skin Moisturization Study – Rinse Off

<table>
<thead>
<tr>
<th>Timepoint (hours)</th>
<th>Placebo Control</th>
<th>Active Wash</th>
<th>Control (Water)</th>
<th>Control (Untreated)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean Corneometer Value

Placebo Control
Active Wash
Control (Water)
Control (Untreated)
Skin Moisturization Study – Rinse Off

Mean Visual Dryness Value

Timepoint (hours)

- Placebo Control Wash
- Active Wash
- Control (Water)
- Control (Untreated)
Cola®Moist 200 Applications

• Hair Care
  - Shampoos
  - Conditioning creams and rinses
  - Frizz/flyaway control
  - Volumizing products

• Personal Care
  - Soap bars
  - Liquid soaps
  - Facial cleansers

• Skin Care
  - Dry skin lotions and creams
  - Daily wear moisturizers

• Baby and Sensitive Skin Care
### Base Formulation

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isopropyl Palmitate</td>
<td>5</td>
</tr>
<tr>
<td>Glyceryl Stearate &amp; PEG-100 Stearate</td>
<td>3</td>
</tr>
<tr>
<td>Coconut Oil</td>
<td>3</td>
</tr>
<tr>
<td>Coco-Caprylate</td>
<td>2</td>
</tr>
<tr>
<td>Cetyl Alcohol</td>
<td>1</td>
</tr>
<tr>
<td>Water to 100</td>
<td></td>
</tr>
<tr>
<td>Citric Acid to pH 6</td>
<td></td>
</tr>
</tbody>
</table>

### Emulsion Stabilizers

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cetyl HEC</td>
<td>0.3</td>
</tr>
<tr>
<td>Guar Gum</td>
<td>0.8</td>
</tr>
<tr>
<td>Xanthan Gum</td>
<td>0.6</td>
</tr>
<tr>
<td>Carbomer</td>
<td>0.2</td>
</tr>
<tr>
<td>High CD Guar Quat</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### Results with 3% Cola®Moist 200

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>P/F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cetyl HEC</td>
<td>Pass</td>
</tr>
<tr>
<td>Guar Gum</td>
<td>Pass</td>
</tr>
<tr>
<td>Xanthan Gum</td>
<td>Pass</td>
</tr>
<tr>
<td>Carbomer</td>
<td>Fail</td>
</tr>
<tr>
<td>High CD Guar Quat</td>
<td>Fail</td>
</tr>
</tbody>
</table>
Viscosity Response Curve in Shampoo Base

- Additions of nominal amounts of Cola\textsuperscript{®}Moist 200 will promote a salting effect in traditional surfactant cleansing systems.
- Formulators may be able to completely avoid adding sodium chloride to a system with Cola\textsuperscript{®}Moist 200.

![Salt Curve for ColaMoist 200 in a Shampoo Base](image-url)
Hair Moisturization

HAIR MOISTURIZATION

I DO NOT THINK THAT MEANS WHAT YOU THINK IT MEANS
Cola®Moist 200 Promotes Coacervation

Turbidity Results for Dilutions of Base Formula (11.5% SLES-2, 2.6% DSCADA, 0.5% PQ-10) in DI Water

Increased Coacervation

Broadened Dilution Range for Complex Formation
Cola®Moist 200

Dia-Stron Wet Combing Results for Base Formula (11.5% SLES-2, 2.6% DSCADA, 0.5% PQ-10) on bleached brown hair

![Graph showing reduction in peak wet hair combing force and total work with ColaMoist 200]
## Cola®Moist 200 in Formulation

### Nourishing Hand Wash (Sulfate-Free, Betaine-Free) # 4040

<table>
<thead>
<tr>
<th>INCI Name</th>
<th>Trade Name</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Water</td>
<td>qs to 100.00</td>
</tr>
<tr>
<td>Water, Sodium C14-16 Olefin Sulfonate, Cocamidopropyl Hydroxysultaine, Cocamide MIPA</td>
<td>Cola®Det DEF-61</td>
<td>35.00</td>
</tr>
<tr>
<td>Hydroxypropyl Bis-Hydroxyethylidimonium Chloride</td>
<td>Cola®Moist 200</td>
<td>3.00</td>
</tr>
<tr>
<td>Water and Glycol Distearate and Sodium Hydroxypropylphosphate Decylglucoside Crosspolymer and Cocamidopropyl Hydroxysultaine and Sodium Stearoyl Lactylate</td>
<td>Suga®Det EcoPearl</td>
<td>3.00</td>
</tr>
<tr>
<td>Sodium Benzoate and Potassium Sorbate</td>
<td>Euxyl® K712 (^1)</td>
<td>1.00</td>
</tr>
<tr>
<td>Fragrance</td>
<td>Oud Fragrance (^2)</td>
<td>0.20</td>
</tr>
<tr>
<td>Citric Acid</td>
<td>Citric Acid, 50%</td>
<td>qs to pH 5.5 – 6.0</td>
</tr>
</tbody>
</table>

### Typical Properties

- **Appearance**: Pearled, Viscous Liquid
- **pH**: 5.5 – 6.0
- **Viscosity**: 4,000 – 6,000 cP
- **% Solids**: 15.8 – 17.4
Time Lapse Demo

• Click here for video on Vimeo
Wrap Up

• Humectants are important tools for skin moisturization

• Nature-inspired synthetic products can offer new benefits

• Formulators need to conduct a rational approach to demonstrating efficacy

• Improved moisturization from rinse-off products is possible
Webinar Series – Coming Events

- April 30 – Surfactants 101
- May 7 – Salt-free Surfactants
- May 14 – Alternate Preservation
- May 21 – Dioxane-Free Formulas
- May 28 – Sulfate-Free Formulas

Thank you!

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