Cleanser-Induced Effects on Skin Barrier Function

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Why Study Skin Decontamination?

1. Decontamination is common and necessary at the worksite.
2. Improve dermal policy recommendations. Currently: Soap & water
3. Which cleanser is best for which type of chemical?
   - Efficacy of decontamination
   - Cleanser-induced enhancement of skin permeability ("Wash-in" effect)

This Preliminary Study: Do candidate cleansers change barrier function?
How is Skin Barrier Function Measured?

• Water permeation of the skin barrier is slow
  - Damaged skin is more permeable
  - $^{3}$H$_2$O penetration (Barrier Assay, BA)

• Change in Barrier Function
  - Statistically significant difference in % penetration, due to treatment.
  - “Damage”: Penetration of $>$0.29-0.35% of applied dose
Experimental Model for In Vitro Decontamination

Hairless guinea pig skin
- Human-like in stratum corneum, epidermal thickness.
- History of use in skin chemical absorption studies
- Female, age 29-33 months, dorsal skin

Do candidate cleansers change barrier function with one treatment?
- Flow-Through Diffusion Cell (FTDC) System with skin punches
- $^3\text{H}_2\text{O}$ BA #1 $\rightarrow$ Cleanser $\rightarrow^3\text{H}_2\text{O}$ BA #2
Treatments: 2 controls, 5 cleansers

No Abrasives, Removable with water

<table>
<thead>
<tr>
<th>Wa</th>
<th>Water</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Nothing (no cleanser, no rinse)</td>
<td>Control - storage</td>
</tr>
<tr>
<td>IvL</td>
<td>Ivory Liquid (10%)</td>
<td>Hydrophilic</td>
</tr>
<tr>
<td>DT</td>
<td>D-TAM (100%)</td>
<td>Hydrophobic</td>
</tr>
<tr>
<td>SS</td>
<td>Safe Solvent (100%)</td>
<td>Broad Range – very hydrophobic</td>
</tr>
<tr>
<td>NSm</td>
<td>Natural Smooth Orange (100%)</td>
<td>Broad Range – very hydrophobic</td>
</tr>
<tr>
<td>Clo</td>
<td>Clorox (0.5%)</td>
<td>Biologic Contam.</td>
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</tbody>
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Flow Through Diffusion Cell (FTDC)

Donor \(^{3}\text{H}_2\text{O}\)

Skin

Receptor Buffer: \(^{3}\text{H}_2\text{O}\)

\(^{3}\text{H}_2\text{O} \text{ %}

Penetration
Procedure

1. Harvest skin & freeze (–85°C, 5-8 mo.)
2. Dermatome skin (310-400μm), punch disks
3. Weigh & randomize to FTDC cells
4. BA#1
5. Overnight

6. Randomize intact disks to treatments (cleanser or control).
7. Acetone onto all disks, 2 hr rest.
8. Treatment, 2 rinses, 2 hr rest.
9. BA#2
Data Analysis

1. What is the % penetration for each treatment group?
   - BA#1: % penetration before cleanser
   - BA#2: % penetration after cleanser
   - BA#2 - BA#1: change in % penetration

2. Calculate total % recovery (mass balance).
   - 70% to 83%

3. Three animals: Total of 4-6 disks/treatment
Does BA#2 show Treatment Effects with one Cleanser Treatment?

Treatment effect (skin disk wt is covariate)
BA#2 ANOVA p = 0.018
Does BA#2 - BA#1 show Treatment Effects with one Cleanser Treatment?

Treatment effect (skin disk wt is covariate)  
ANOVA p = 0.0308
Does BA#2 - BA#1 show Treatment Effects with one Cleanser Treatment?

![Graph showing treatment effects with cleanser treatments.]

**Treatment Group**
- Wa (6)
- No (5)
- IvL (6)
- DT (6)
- SS (5)
- NSm (6)
- Clo (4)

**% $^3$H Pen. +/- SD**
- p=0.031
- p=0.039
- p=0.123
- p=0.377

**Treatment effect (WITHOUT skin disk wt covariate) ANOVA p = 0.0317**
Conclusions

The two more broad-range cleansers that are intended to remove very hydrophobic greases decreased barrier function after one application.

This decrease in barrier function was insufficient to be considered “damaging” according to conventional laboratory criteria.
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