Surfactant Association with Hydrophobically-Modified Polymers Leads to Reduced Barrier Perturbation

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INTRODUCTION
While maintaining a strong SC barrier is important for patients with various conditions, even mild cleansers can disrupt the SC barrier. Low molecular weight hydrophobically-modified polymers (HMPs) are particularly efficient at associating surfactant such as sodium laurel sulfate (SLS) due to the strong interactions with the hydrophobic tail of the surfactant with the hydrophobic domains on the HMP. We have found that surfactant associated with the HMP lowers the effective concentration of free surfactant micelles in solution and reduces the amount of surfactant that penetrates into the skin, thereby reducing the disruption of skin lipids. However, these formulations can still provide the desirable foaming aesthetics and cleansing efficacy desired by patients (data presented elsewhere). Here we show that these large polymer-surfactant complexes are less aggressive to the lipoid barrier in the stratum corneum than traditional cleansing systems.

In this study, porcine skin samples were exposed to either a facial cleanser formulation incorporating a hydrophobically-modified polymer (HMP) (foaming and non-foaming variants) or a commercially available benchmark facial cleanser noted for gentleness (foaming and non-foaming variants). Methods

Materials
• Full-thickness Yucatan miniature hairless pigskin was obtained from Sinclair Bio-Resources of Auxvasse, Missouri and cut into 2” x 2” specimens.
• Cleansing formulations:
  a. facial cleanser formulation incorporating a hydrophobically-modified polymer (HMP) (foaming and non-foaming variants)
  b. commercially available benchmark facial cleanser noted for gentleness (foaming and non-foaming variants)
  c. phosphate buffer solution (control)
  d. 1% sodium laurel sulfate solution (negative control)

Methods
• Full-thickness pigskin was mounted in Franz diffusion cells, with phosphate buffer as the receiving solution. The cleansing formulations were diluted with water to 10% and placed in passive diffusion systems.

The skin samples were exposed to either a facial cleanser formulation incorporating a hydrophobically-modified polymer (HMP) or a commercially available benchmark facial cleanser noted for gentleness (foaming and non-foaming variants) for 20 minutes. The skin samples were rinsed and cleaned with a lipophilic fluorescent dye, Nile Red (NR) and two-photon fluorescence microscopy was used to study the morphology of the skin barrier. All TPM images shown here were obtained 24 hours deep into the skin.

RESULTS

Figure 1. This is a schematic of NR dye diffusion into skin. Skin cells and intact barrier resist diffusion of the dye. Therefore, low fluorescence intensities (FI) will be observed in areas where the barrier is more intact. Damaged barrier (lightly cross hatched) provides less resistance to diffusion, allowing more NR to easily penetrate deeper into the skin. Therefore, there will be higher FI in areas where the barrier is damaged.

Figure 2a shows the images of cells for the control skin. There is limited NR penetration into this intact barrier.

Figure 2b shows the TPM images of SLS treated skin. Higher intensity of NR shows that there is large penetration of NR indicating the great extent of barrier damage.

Figure 3a shows skin treated with the dermatologist recommended benchmark foaming cleanser. Higher intensity of NR compared to the control indicates penetration of fluorescent dye due to barrier damage.

Figure 3b shows skin treated with the foaming HMP facial cleanser. NR intensities are lower than that of the benchmark foaming cleanser suggesting lower levels of barrier damage.

CONCLUSIONS
• Incorporating hydrophobically-modified polymer into cleansing formulations allow cleaning efficacy and foaming without perturbing the skin barrier.
• The foaming HMP facial cleanser incorporating a hydrophobically-modified polymer was gentler to the skin barrier in this model than the dermatologist recommended benchmark foaming cleanser.
• The non-foaming HMP facial cleanser was as barrier-preserving as the benchmark cleanser.

Reference