ORIGINAL CONTRIBUTION

Evaluation of the Relative Mildness of Commercial Sensitive Skin and Baby Laundry Detergents

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ABSTRACT

Laundry detergents that are free of fragrances and dyes should be recommended to patients with sensitive skin. To ensure mildness of these products, manufacturers typically conduct patch testing. A new method, which is more discerning than patch testing, called Detergent Mildness Index (DMI), has been described previously. Using the DMI method, 12 sensitive skin/baby laundry detergents, representing the top 85% of the marketplace, were evaluated. The product "all Free Clear®" was found to be the mildest liquid laundry detergent. (*SKINmed*. 2020;18:14–16)

The mildness of laundry detergents is typically assessed using patch testing, wherein fabric is washed and dried for multiple cycles, then occlusively applied to the skin of healthy subjects.[1] This indirect skin exposure to detergent residues does not always differentiate between products, likely because healthy subjects rather than patients with atopic dermatitis or other sensitive skin diseases are used. This has been illustrated by a recent study that utilized a 21-day cumulative occlusive patch test to compare the two leading free clear liquid laundry detergents, showing comparable erythema results.[2]

A method called the Detergent Mildness Index (DMI) was developed to better differentiate between commercial laundry detergents.[3] The DMI method was used to guide reformulation of the leading sensitive skin-free clear laundry detergent. In this study, the method was used to test current market laundry detergents because commercial products been reformulated and new products have entered the marketplace since the original testing in 2016.

METHODS

Twelve sensitive skin and baby liquid laundry detergents, were purchased in October 2018 to represent the top 85% of the marketplace, were evaluated. The products, which were obtained from retail stores in the vicinity of Trumbull, CT, included 'all free Clear® (leading sensitive skin detergent), Tide Free & Gentle® (second leading sensitive skin detergent), Dreft Newborn Baby® (leading baby detergent), and nine other liquid laundry detergents that make up the remaining 85% sensitive skin laundry detergents in marketplace. The total surfactant concentration ranged from about 10% to 28%.

DMI is a combined score derived from three individual *in vitro* and *ex vivo* measurements, commonly used to assess surfactant harshness on skin in the personal care industry.[3] The tests include Zein, Corneosurfametry, and Cytokine. The averages of results from each test are scaled to a mean of 50, and the normalized scores are added together to achieve the DMI value.

The *in vitro* Zein test assesses a detergent's potential to denature the proteinaceous components of the stratum corneum, which contributes to irritancy. Zein is a corn protein, which is insoluble in aqueous solution unless it is denatured. Skin irritancy is predicted by measuring the amount of zein solubilized after exposure of the protein to detergent solution.[4] Laundry detergents were tested at 10% concentration, and trials were run in duplicate.

Corneosurfametry is an *ex vivo* method in which superficial layers of the stratum corneum are collected by tape stripping and exposed to dilute surfactant solution that is stained. The more the lipid remains in the skin layers on the tape, the less the layers take up the stain. This test measures the potential of the detergent to remove stratum corneum lipids, which also contribute to irritancy potential. Adhesion

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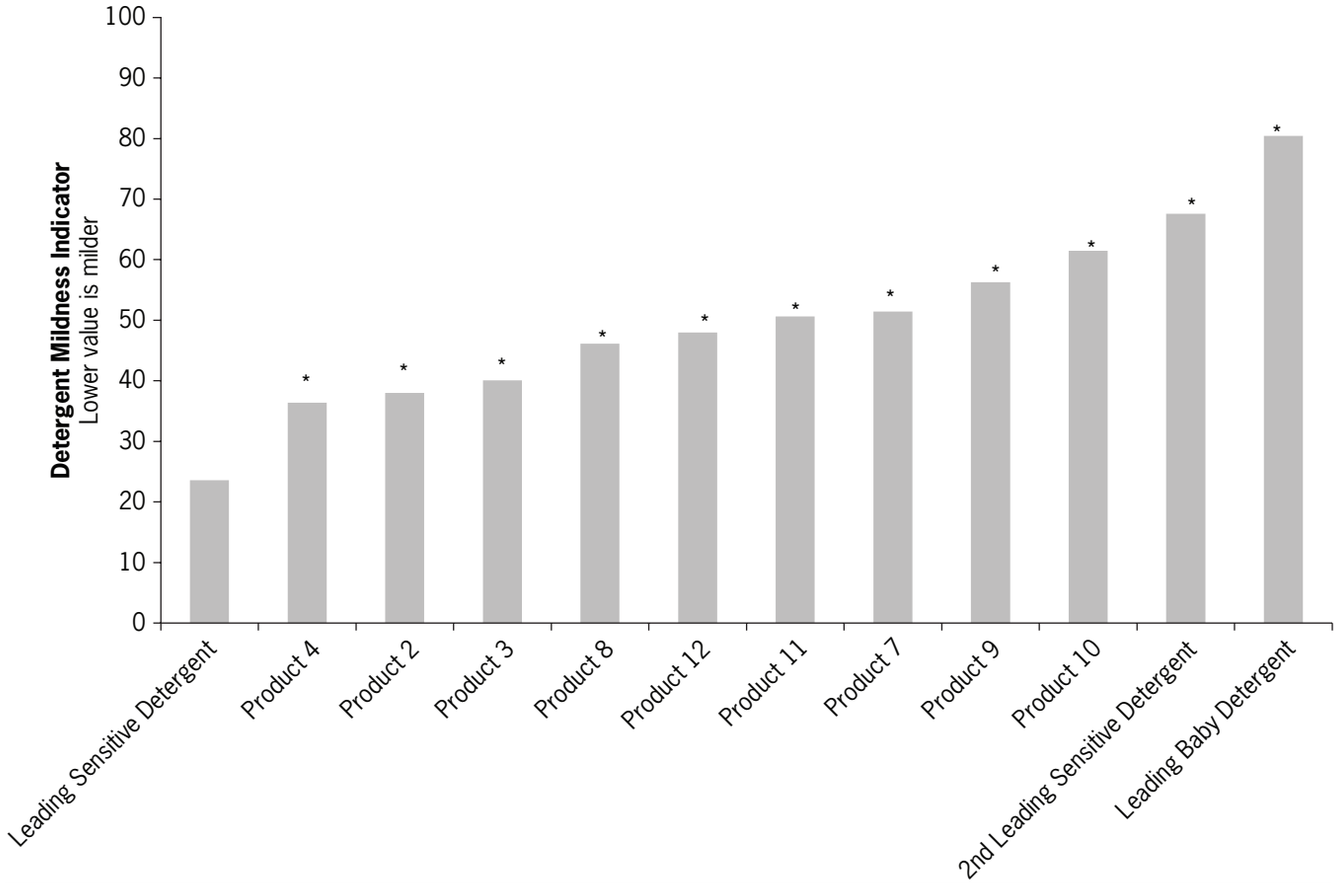

Figure 1. Detergent Mildness Index (DMI).
DMI = (% zein solubilized) + [CSM 100 – (L* – C*)] + (IL – 1a); scaled to mean = 50.
*Statistically, the DMI value is significantly different from the DMI of leading sensitive detergent.

of stain to the skin cells is measured by reading the color of samples using reflectance colorimetry. Higher color readings are an indication of higher potential for skin irritancy.[5] Laundry detergents were tested at 10% concentration with an average of 10 panelists.

The *in-vitro* Cytokine test utilizes full thickness skin cells from an EpiDerm skin model to measure the inflammatory response of the skin cells to a dilute solution of detergent. The inflammatory cascade is stimulated if keratinocytes in the epidermal layer secrete cytokines. The release of cytokine interleukin 1a (IL-1a) is measured. The more irritating the detergent, the more IL-1a is released. Laundry detergents were tested at 3% concentration, and trials were conducted in triplicate using the procedure described previously.[3]

RESULTS

The DMI score (Figure 1) shows that the leading sensitive skin detergent is the mildest formula in this testing. This result is consistent with previous DMI testing. Additionally, in each of the three individual tests comprising the DMI score, the mildest formula was the leading sensitive skin detergent.

CONCLUSIONS

The DMI testing was conducted using current commercial sensitive skin laundry detergents representing 85% of the marketplace in this category. Repeating the test was necessary, as new products have entered the marketplace and older products have changed formulas. The leading sensitive skin detergent, which is the commercial 'all Free Clear® product, remains the mildest formula tested. This formula was developed in 2016 using guidance from dermatologists and was optimized using the three tests.

While many laundry detergents are marketed for sensitive skin by simply removing fragrances and dyes, this testing demonstrates that the irritation potential between seemingly similar products is different. Although these results represent laboratory findings,

rather than clinical testing, it serves as guidance for selecting the mildest laundry detergent formulation.

DISCLOSURE

Matthew Zirwas, MD, is a paid consultant of the Henkel Corporation. Janet Coope-Epstein and Alma Calderon are employees of Henkel. This work evaluated products marketed by Henkel. Work was funded by Henkel.

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