A novel evaluation system to capture dynamic skin friction during rinsing

NT_367

Jiang, Yueming; Yin, Yuanyuan; Qu, Xin*
Shanghai Technical Center, ASHLAND LLC, Shanghai, China

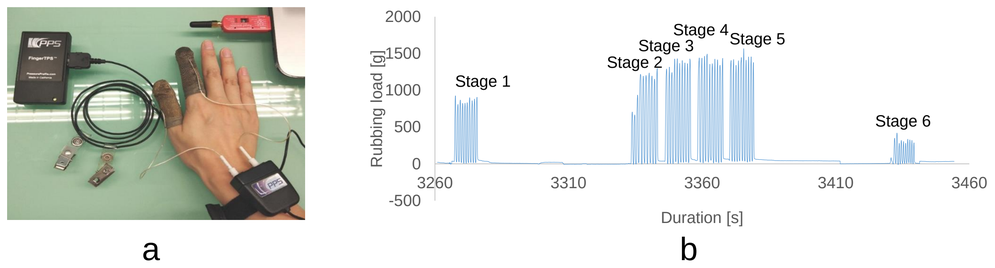
Introduction:

The slippery level and duration time during washing stage are among the most important aspects of bath products. Up to now, these aspects can only rely on sensory evaluation by a well-trained panel or large-scale market research. The existing instruments, such as Frictiometer, can measure the friction values on the skin, but only at static dry state. There are no instruments/methods developed to characterize objectively and dynamically the skin friction during rinsing. To solve this gap, a novel evaluation system has been developed to assess dynamic skin friction during washing stage by special designed instrument. Three commercial bodywashes, soap-based and surfactant-based systems, were used to validate the slippery level and duration time during washing stage. The difference between soap-based bodywash rinsed with tap water and deionized water, as well as the influence of added polymers, such as hydroxyethyl cellulose, or hydroxypropyl methylcellulose, were also evaluated.

Materials & Methods:

Dynamic skin friction measurement

The system includes a fingertip sensor (Finger TPS system, PPS, USA) to measure the force applied on a scientifically selected facial brush before product application, during rinsing under flowing water and after rinse stages (figure 1a). The whole product application process was divided into 6 stages, and the skin was brushed for 10 times at each stage (figure 1b). 3 different commercial bodywashes were measured. The average force, max. and min. force applied were recorded and differences to baseline value were analyzed to reduce individual skin variation.



a b

Figure 1. Dynamic skin friction measurement with a Finger TPS system

Sensory evaluation

The Finger TPS data obtained were validated by a well-trained sensory panel (10 females aged from 35-55). The sensory attributes included, as shown in table 1, scaled from 0 to100 (0, not detected; 100, high intensity).

Table 1. Sensory attributes evaluated in the study

Phases	Sensory Attributes	Definition
Before rinsing on wetted skin	Squeaky feel	The frictional drag felt by fingers rubbing on the skin.
During rinsing	Squeaky feel	The frictional drag felt by fingers rubbing on the skin during the first 10-15 washing motions on skin.
	Easy to rinse off	Duration of time until skin feels clean.
After Feeling on dried skin	Roughness	The tactile perception of skin surface roughness.

Skin friction coefficient measurement with Frictiometer (FR 700, CK)

The validation between Finger TPS and Frictiometer measurements were conducted on dried skin. 3 repeats were conducted in the middle of volar forearm.

Application study

The control without added polymers and test samples with 0.7% hydroxyethyl cellulose (HEC), or hydroxypropyl methylcellulose (HPMC K35M or HPMC K100M) were prepared and measured with Finger TPS. The irritations to stratum corneum were examined using corneosurfametry method [1].

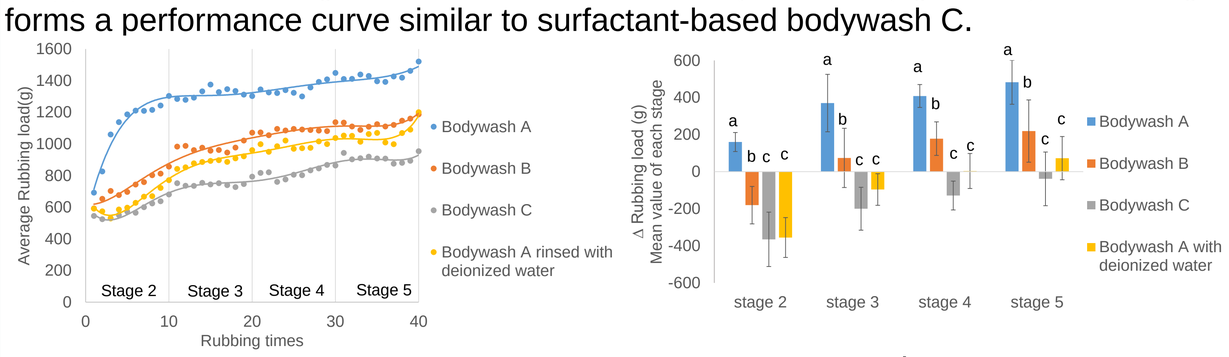
Statistical analysis

The data obtained was analyzed with One-way analysis of variance or Wilcoxon signed rank test, depending on whether the data followed a normal distribution.

Results & Discussion:

Dynamic skin friction measurement of 3 commercial bodywashes

Under tap water rinsing, there is significant difference of dynamic friction values among three commercial bodywashes. The skin friction of soap-based bodywash increased rapidly to the highest value within the shortest time, while surfactant-based bodywash showed the lowest value with the longest time, as shown in figure 2a. When soap-based bodywash A rinsed off with deionized water, the skin friction dropped down, no significant difference with bodywash C (figure 2b), indicating it forms a performance curve similar to surfactant-based bodywash C.



a b

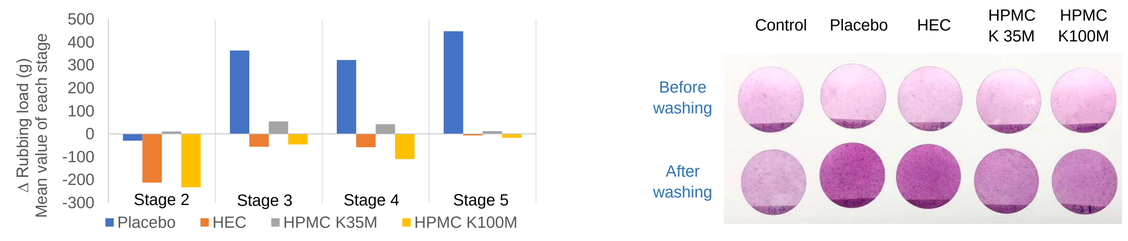
Figure 2. Comparison of 3 commercial bodywashes during rinsing (stage 2 to 5). *a-c: same letter at the same stage indicates no significant statistical differences ($p>0.05$)

Correlation with sensory evaluation and Frictiometer (FR 700, CK)

The data obtained were compared to a well-trained sensory panel (10 panelists) and to the data from Frictiometer on dried skin. The results correlate well with panel grading ($R^2=0.91$) and with Frictiometer data ($R^2=0.95$).

Application study

The results showed 0.7% hydroxyethyl cellulose, or hydroxypropyl methylcellulose, could neutralize the squeaky feel (figure 3a), make the skin smoother and less irritated after washing (figure 3b).



a b

Figure 3. a): Comparison of soap-based samples added with/without 0.7% hydroxyethyl cellulose, or hydroxypropyl methylcellulose during washing. b): The photos of first stratum corneum layer after staining. The intensity of the color corresponds to the skin barrier damage.

Conclusions:

A novel evaluation system has been developed to assess dynamic skin friction by instrument, which can objectively and sensitively characterize the performance of cleansing products during entire application process. Different wash-off system has different performance in rinsing. This new method showed good correlation with sensory evaluation and Frictiometer through measurements of 3 commercial bodywashes. Soap-based cleansing products is squeaky during washing and harsh to skin. Addition of polymers to cleansing products can further protect skin, neutralize the squeaky feel, and improve moisturization. This new method is of great value in supporting product development and predicting sensory properties during shower and cleansing experience.

Aknowledgments:

This work was supported by Ashland LLC. The author would also like to thank the Ashland expert panel for their participation.

References:

[1] Wenjia L, Xiaomin Z, Xiaohui W, Xin Q*, Lei X, Jianhua L, Faling L (2020) Assessing potential irritation of shampoo by corneosurfametry. The 31st IFSCC Congress Yokohama.