INFLUENCE OF CLEANSING PRODUCT TYPE ON SEVERAL SKIN PARAMETERS AFTER SINGLE USE

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Abstract

With the increasing use of skin cleansing products, the awareness of products-induced skin irritation, itching, dry skin and other potential effects has also increased. In this paper we studied the influence of some skin cleansers on skin properties that may be influenced by their use: skin surface pH, *stratum corneum* water content and transepidermal water loss (TEWL). Six commercially available skin cleansers were used in this study: a soap bar, a superfatted soap bar, a transparent soap bar, a combar, a superfatted solid syndet and a liquid syndet. Each product was tested on 20 healthy volunteers, without clinical signs of dermatological or allergic diseases. Tap water was used for hand washing, and the washing time was in all cases 1 minute. Skin measurements, skin pH, skin surface hydration or hydration of *stratum corneum* and transepidermal water loss were performed before skin washing at several time intervals after washing.

All studied parameters were influenced by the products, but in different ways and with different intensities. The parameter which was most influenced by the test products was the pH value. All products had a drying effect on *stratum corneum*, depending on the product composition. Transepidermal water loss (TEWL) measurements showed very small differences between measurements performed before hand washing and those performed after washing.

The changes of skin parameters after the single use of cleansing products are reversible and in the case of a healthy skin they return to normal values in about 90 minutes after washing.

Rezumat

În acest studiu s-a urmărit influența unor produse de igienă a pielii asupra unor parametri ai pielii care pot fi influențați de aceste produse: pH-ul de la suprafața pielii, gradul de hidratare a stratului cornos şi pierderea de apă transepidermică (TEWL).

Fiecare produs a fost testat pe pielea a 20 voluntari sănătoşi, fără probleme dermatologice. Pentru spălare s-a utilizat apa curentă, durata spălării fiind de 1 minut. Măsurarea parametrilor pielii s-a efectuat înainte de spălare şi la diferite intervale de timp după spălare. Toți parametrii urmăriți au fost influențați de produsele utilizate, dar în mod diferit şi cu o intensitate diferită. Cele mai importante modificări s-au înregistrat în cazul valorilor de pH. Toate produsele testate au avut un efect sicativ mai mult sau mai puțin important şi persistent, în funcție de compoziția produsului. Parametrul cu modificările cele mai reduse a fost pierderea de apă transepidermică.

Modificările parametrilor pielii înregistrate după o singură utilizare a produselor sunt reversibile, înregistrându-se revenirea la valorile inițiale a tuturor parametrilor evaluați, după aproximativ 90 minute de la utilizarea lor.

Keywords: cleansing products, skin pH, hydration, TEWL.

Introduction

Skin cleansing products may contain various surfactants, with different performances, in order to remove unwanted materials from the skin surface (dirt, sweat and excess sebum) and also to help promoting normal exfoliation [2]. When surfactants are applied on the skin, they interact with skin structures, particularly with lipid and protein components [7], and may determine important skin toxicity at high concentrations [3].

Cleanser surfactants may induce protein denaturation or they can bind to *stratum corneum* proteins, leading to transient swelling and hyper-hydration in the moment of washing. This is followed by the water-evaporation when a deswelling process appears, leading to skin drying. Also, the surfactants reduce the surface tension of water at the skin surface and remove the lipids from the skin, below the critical micelar concentration (CMC), or they may solubilize the lipids into micelles at concentrations above CMC [2, 5, 7, 9].

The degree of skin damage by cleansing products depends on surfactant type, product formulation, especially the quality and the quantity of lipids added to the formulation, and also on the method of use (frequency and contact time) [1].

Thus, skin barrier may be affected by the surfactants from cleansing products; the degree of barrier injury may be evaluated by measuring the transepidermal water loss (TEWL), which represents the evaporation of water from the skin surface. Skin barrier damage leads to increased TEWL values.

Basically there are two types of cleansing products: those with soap-based surfactants, which are anionic type and referred to as “bars” and those with non-soap-based surfactants, which are often a combination of anionic, amphoteric and less frequent non-ionic type and are referred to “syndet” [2, 8, 13].A new category is that which contains both soap-based and non-soap-based surfactants, being named “combars”. All three categories may be enriched with lipids in order to increase the mildness of the cleansing product and to reduce the detergent-induced skin barrier disfunction [10, 13, 14]. Bars generally form aqueous solutions with alkaline pH (pH = 9-11); combars may give a neutral pH to their aqueous solution, while syndets may give slightly acidic pH to their aqueous solutions. These pH differences may have

important implications in the degree of damage induced to the skin by the cleansing products, high pH values being associated with skin irritancy and significantly higher swelling [1, 2, 8, 11, 13].

Thus, surfactants may have an influence on cutaneous barrier and on some skin properties as surface pH and hydration, manifested by skin roughness, erythema, stinging sensations and pruritus, which were described often following cleansing product use. In some cases skin barrier disruption is caused even on healthy skin, by the inappropriate use of these cleansing products [2, 5, 6, 10].

In this study we have assessed the influence of several cleansing products on healthy skin properties: the skin surface pH, the *stratum corneum* hydration and also the skin barrier by TEWL measurements, after single use of these products.

Materials and methods

Formulations

Six commercially available cleansing products were used in this study; their composition is presented in table I.

Table I

Composition of the tested cleansing products

Cleansing product type	Composition
Soap bar (A)	Surfactants: > 30% soap (sodium tallowate) Stability and perfuming agents
Lipids enriched soap bar (B) Superfatted soap	Surfactants (soap based): Sodium tallowate, Sodium cocoate, Sodium palm kernelate Lipids: Octyldodecanol, Prunus Dulcis (Oil), Lanolin Alcohol Humectant: Glycerin Stability and perfuming agents
Transparent soap (C)	Surfactants: Sodium Tallowate, Sodium Palmate, Sodium cocoate Lipids: Coconut Acid Humectants: Glycerin, Sorbitol Stability and perfuming agents
Combar (D)	Surfactants: - Soap based: Sodium Palmitate, Sodium Stearate, Sodium Palm Kernelate - Non-soap based: Sodium Isethionate, Sodium Lauroyl Isethionate, Cocamidopropyl Betaine Lipids: Stearic Acid, Lauric Acid pH regulator: Citric Acid Humectant: Glycerin Stability and perfuming agents

(continued)

Table I (continued)

Lipid enriched solid syndet (E) Superfatted syndet	Surfactants (non-soap based): Disodium Lauryl Sulfosuccinate, Sodium cocoyl isethionate, Glyceryl stearate, Cocamidopropyl betaine Lipids: Cetearyl Alcohol, Paraffin, Octyldodecanol, Lanolin Alcohol pH regulator: Citric Acid Stability and perfuming agents
Liquid syndet (F)	Surfactants (non-soap based): Lauramidopropyl Betaine, Sodium Laureth Sulphate, Lauramide MEA Humectant: Glycerin Stability and perfuming agents

Sodium tallowate is considered to be a harsh surfactant; sodium palmate, sodium cocoate, sodium palm kernelate are considered milder, while the mildest are considered sodium cocoyl isethionate, sodium isethionate and disodium lauryl sulfosuccinate [12, 13].

Methods

Six groups of 20 volunteers (males and females), between 20-25 years old, were selected to participate in the study. The exclusion criteria were: the presence of clinical signs of dermatological or allergic diseases and/or a history of clinical signs of dermatological diseases. Informed consent was obtained for all participants prior to the study. They were informed about the nature of test and about the possible adverse reactions.

For *stratum corneum* water content and TEWL measurements were performed before hand washing and at 40 min and 90 min after they washed their hands with one of the selected cleaning products. For the pH evaluation, measurements were performed at the above mentioned intervals but also at 1 min after hand washing. Tap water was used for hand washing, and the washing time was in all cases 1 minute.

All measurements were performed in controlled conditions of relative humidity (45% ± 2%) and temperature (22^0 ± 2^0C). In order to acclimatize at room conditions, volunteers were asked to stay in the test room for at least 1 h prior to the measurements.

Devices for skin measurements

The measurement of the pH level on the skin surface was made using skin pH-meter (Courage-Khazaka, Germany).

The device used to perform the *stratum corneum* hydration measurements is the corneometer (Courage-Khazaka, Germany) which measures the *stratum corneum* water content at 10-20 μm depth.

An open chamber tewameter (Courage-Khazaka, Germany) was used in order to determine the transepidermal water loss TEWL from skin surface.

Results and discussion

The results showed that all studied parameters were influenced by the products, but in different ways and with different intensities.

The parameter which was most influenced by the test products was the pH. The skin's surface is naturally acidic, ranging from pH 4.5 to pH 6 [3].

As we can observe in figure 1, after hand washing, all soap types increased the pH values. The most important increase was observed at 1 minute after washing, in all cases. Cleansing products based on soap-type surfactants (products A, B and C) raised the mean of pH values with 2.1 – 2.4 units of pH (n = 20, mean ± SD) as compared to the baseline, thus the skin pH was above the normal limits. The product D, a combar, increased the mean pH value only with 1.3 pH units, even if it contained soap-type surfactants. This may be due to the presence of citric acid, a pH regulator in soaps and also to the greater quantity of the non-soap surfactants as compared to the quantity of soap-based surfactants, as we can see from the product ingredient list.

These two factors reduced the raise of pH, as compared to soap-based cleansing products, the mean value obtained being with 0.29 pH units (n = 20, mean ± SD), above the superior limit of normal skin surface pH interval. For cleansing products E and F, which contained only non-soap based surfactants, the mean pH raised with 1 pH unit, but even so, the pH values remained in normal limits.

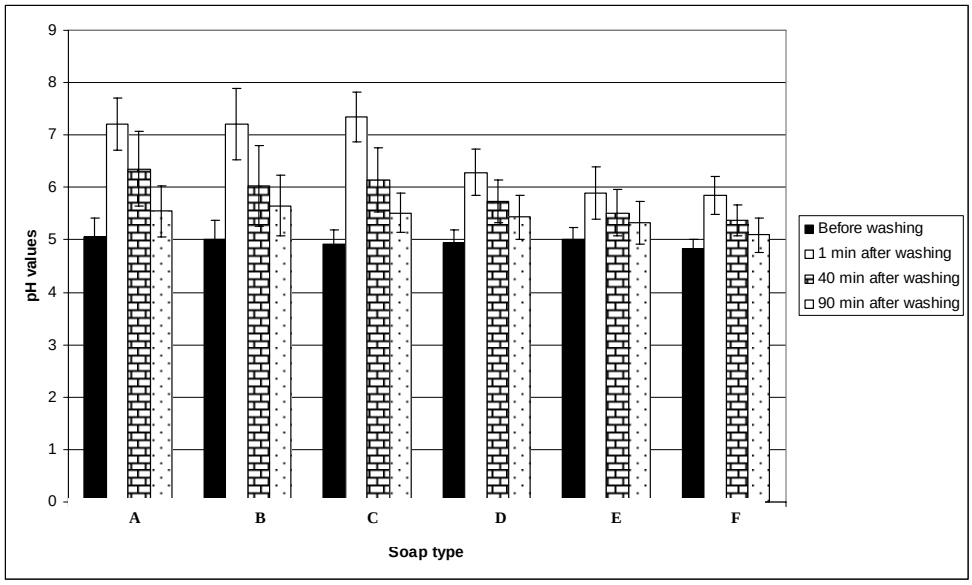

Figure 1

Influence of cleansing product type on skin surface pH, before washing and at 1 minute, 40 minutes and 90 minutes after hand washing (n = 20, mean ± SD).

For the next measurements, performed at 40 and 90 minutes, we observed that the skin pH had a descending tendency, due to the buffering ability of skin, so that after 90 minutes all pH values were included in the normality interval, but above the skin's initial pH value. Thus, to reduce the damage induced by surfactants on skin, an interval of at least 90 minutes is necessary between washings, in order to ensure the reconstruction of the acid mantle of the skin.

The next parameter evaluated was stratum corneum water content. In figure 2 it is shown that all cleansing products had a drying effect on *stratum corneum*, as we can see from measurements performed 40 minutes after hand washing.

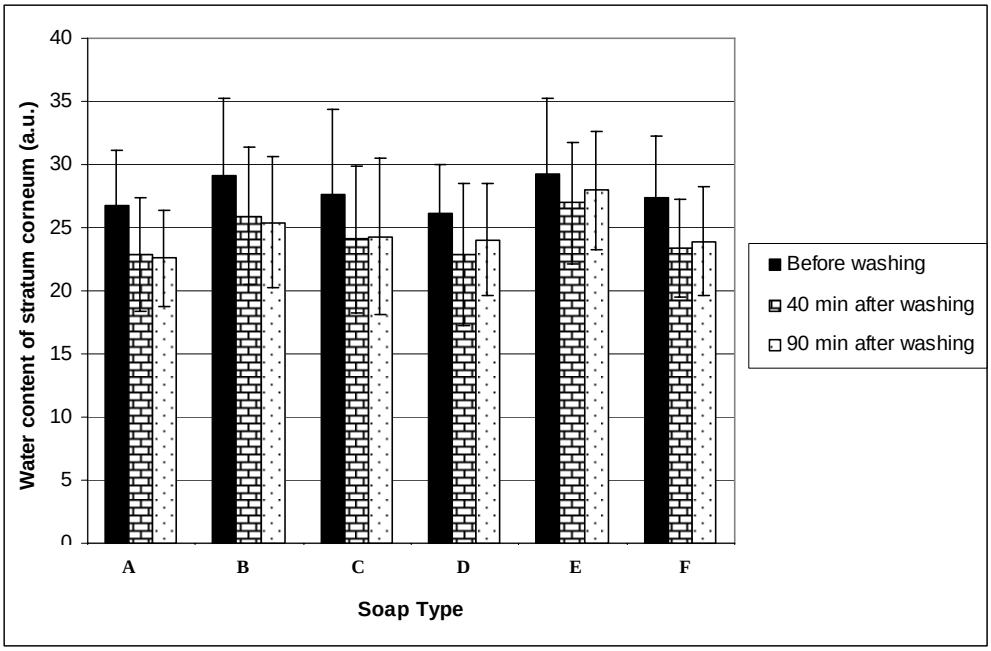

Figure 2
Influence of cleansing product type on stratum corneum water content, before washing and 40 minutes and 90 minutes after hand washing (n = 20, mean ± SD).

The greatest drying effect on *stratum corneum* water content had products A and E, which had soap/based surfactants and had no lipids added to their formulations. Products B, D and E, superfatted by adding fatty acids or oils in their formulation, influenced in a smaller degree the *stratum corneum* water content. The drying effect of product A persisted even after 90 minutes after washing, whilst for product E this was reduced at the same time interval. For the measurements performed 90 minutes after hand washing, excepting product A, in all others cases we could observe a

tendency of skin to repair the stratum corneum water content, as the hydration values were greater than those registered at 40 minutes after hand washing. The product that least influenced the *stratum corneum* water content was product E, the solid superfatted syndet.

The drying effect of product A persisted even after 90 minutes after washing, whilst for product E this was reduced at the same time interval.

The lipids contained by the cleansing products were not able to replace totally the lipids removed from the skin by the surfactants, as it was observed by other authors [5]. They improve skin condition, but cannot eliminate totally the effect of the cleansing products.

Finally, the influence of cleansing products on skin barrier quality was evaluated, from the influence of these cleansing products on TEWL measurements. As we can see from figure 3, all measured TEWL values are in 6-10 $g/m^2 \cdot h$ range, which correspond to a very healthy condition of the skin. Very small differences were observed between measurements performed before hand washing and those performed after 40 and 90 minutes respectively. A small increase of TEWL values is observed after using product A, C and F, while for products B, D and E with extra-lipids added, the TEWL values were reduced. As we expected after a single washing period of 1 minute, the skin barrier is not importantly affected by the use of any type of cleansing products.

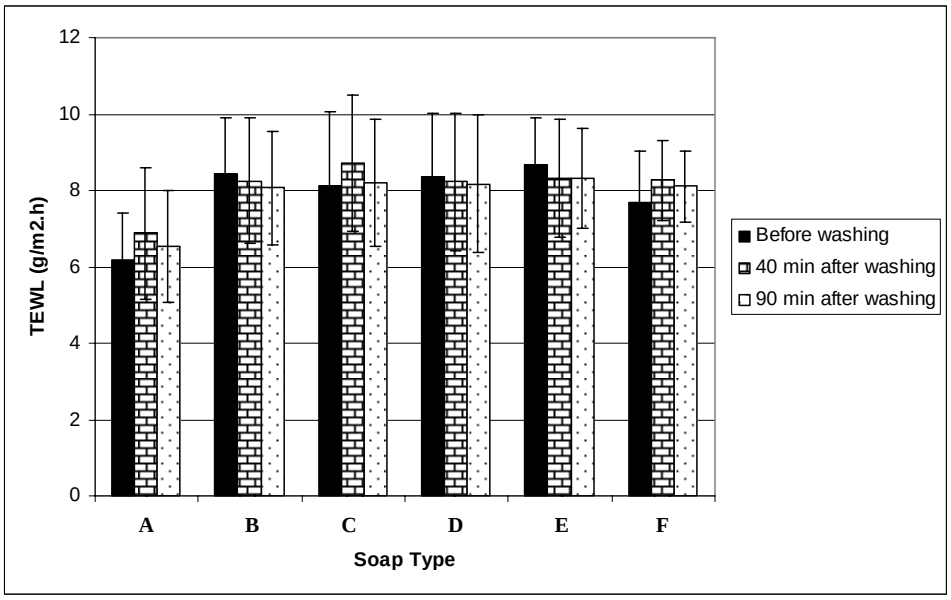

Figure 3
Influence of cleansing product type on TEWL, before washing and 40 minutes and 90 minutes after hand washing (n = 20, mean ± SD).

From the results presented above products A and C may be considered as the harshest to the skin. Product D, even if contained soap-based surfactants, these are classified as milder as compared to those contained in product A and C, also the combination with non-soap surfactant contributed to the milder effect on skin. Product F, even if it contained only non-soap based surfactants, had a harsh effect on skin due to the fact that the surfactants contained were not very mild and also the product wasn't superfatted. The mildest product was product E, that contained the mildest surfactant (Sodium cocoyl isethionate) and was also superfatted.

Conclusions

The use of cleansing products may affect skin parameters even after single use. The optimal cleanser would be one that maintains skin condition by minimizing surfactant damage through the use of mild surfactants, in addition to repairing the skin through delivery of emollients.

Cleansing products containing soap-based surfactants affect the skin by raising its pH values, reducing the stratum corneum water content and an increase of transepidermal water loss (TEWL). Lipids added to products formulation have the tendency to reduce the damage to the skin by reducing the interactions between surfactants and skin lipids and also by a partial replacing of skin lipid barrier removed by washing. However, lipids cannot reduce the effect of these products on the pH values. Citric acid acts as a pH regulator both in soap-based and non soap-based containing surfactants, reducing their alkalinity, and thus reducing the irritancy to the skin, primarily for soap bars. Superfatted syndets are the mildest cleansing products, they don't raise the pH values above normality and they had a minimal influence on the hydration level and TEWL values.

The changes of skin parameters after the single use of cleansing products are reversible and in the case of a healthy skin they return to normal values in about 90 minutes after washing.

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Manuscript received: 10.06.2009