SHORT REPORTS

Differences in the Skin Surface pH and Bacterial Microflora Due to the Long-term Application of Synthetic Detergent Preparations of pH 5.5 and pH 7.0

Results of a Crossover Trial in Healthy Volunteers

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Skin cleansing preparations consisting of identical synthetic detergents but differing in pH-value (pH 5.5 and 7.0) were applied twice daily on the forehead and forearm of healthy volunteers in a randomized crossover trial. The skin surface pH was found to be significantly higher when the neutral preparation had been used, as was the propionibacterial count (p < 0.005). The number of propionibacteria was significantly linked to the skin pH. Hence even minor differences in the pH of skin cleansing preparations seem to be of importance for the integrity of the skin surface. This should be taken into account when planning the formulation of optimal skin care products.

(Accepted October 16, 1989.)

Acta Derm Venereol (Stockh) 1990; 70: 429-431.

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Repeated washing of normal human skin with alkaline soap or (acidic) synthetic detergent solutions affects both the skin surface pH and its bacterial microflora (1). Similar effects as with soap were also found after using alkaline synthetic detergents (2). These findings also substantiate our opinion that different washing habits can influence the biology of the skin surface, which has previously been questioned (3).

There is currently a debate about whether cleansing preparations based on synthetic detergents should be acidic or neutral. Neutral preparations may be less irritating. Yet so far only commercial preparations with differing chemical composition have been assessed (4). To ascertain whether the wanted effects of synthetic detergent preparations on the skin surface will still be encountered if the pH is 7.0 instead of 5.5, we performed a controlled trial using preparations with identical active ingredients.

MATERIAL AND METHODS

Study population
Six male and 4 female healthy volunteers were enrolled after written informed consent. Their ages ranged between 23 and 34 years (mean 28 years). Five individuals were allotted to a group called A, starting with the application of the synthetic detergent preparation characterized by pH 5.5, the others to group B using a preparation of pH 7.0 first.

Cleansing agents
Both liquid synthetic detergent preparations contained identical proportions of water, nipa-laureth-sulfate and cocamidopropylbetaine; potassium coco-hydrolysed animal protein; PEG-7 glycerinsulfate; cocamidopropylammonium; PEG-10 olive oil; sodium lactate; perfume; benzylalkohol and methylisothiazolmonium; hydrogenized cocoglyceride and tocopherol; niacin and pyridoxine hydrochloride, biotin and amino acids; disodium EDTA; dye CI 47005, CI 61570; BHT and citric acid and ascorbic palmitate (in descending quantitative order). The pH-difference of the preparation was due to a different amount of sodium hydroxide added for adjustment. Both preparations were supplied by Dr. Schadenböck from Sebapharma, Boppard, FRG, preparation A in fact represented a previous commercial formula (Sebamed® flüssig).

pH-determination
For skin surface pH-determination, the flat glass electrode developed by Ingold and evaluated by Schirren (5) was used (Glaselektrode 403-S7, Ingold-Meißotechnik, Steinbach, FRG) being connected to a precision pH-MV-Meter (pH 521, WTW, Weilheim, FRG).

The values given are means of three consecutive measurements. Technical details of application corresponded to the procedure as described by Arbenz (6).

Investigation of the bacterial flora
Sampling of bacterial flora specimens was based on the detergent scrub method (7). The methods for bacterial culture and identification are described in greater detail elsewhere (2).
Converse order (Fig. 1) shows that the change was even more pronounced on day 6. Thus, at the former site, the percentage of confluence was significantly higher on days 17, 24, and 31.

Interdependence of both methods

The number of counts of both bacteria was significantly correlated with the forehead and between forehead and forearm. The correlation between forehead and forearm was significantly lower (0.315) than between forehead and forearm (0.439).

DISCUSSION

Major differences in the number of bacteria in the forearm and forehead have been observed. The skin surface pH and the bacterial counts were significantly higher on the forehead and on the forearm (2). The results of the study show that the previous findings, which demonstrated that even minor differences in the concentration of bacteria, may have a corresponding effect on both skin surfaces. Although the differences were most pronounced when synthetic detergents were used, the pH 7.0 was used in a comparison with the application of a pH 8.5. The effects are in the direction of a more acidic synthetic detergent, which is relatively more alkaline and favorable for bacterial growth.

High propionic acid levels have been linked to adolescent acne. This suggests that those who do not share this condition are more likely to have lower levels of skin surface pH and bacterial counts.
Interdependence of bacterial counts and pH values

The number of coagulase-negative staphylococci was significantly correlated with the skin pH on the forehead, but not on the forearm. The r-value, however, was comparatively low at both sites, amounting to 0.315 and 0.155, respectively. Propionibacterial counts at both sites were linked to the skin pH in a significant manner, the r-value also being comparatively low (0.385) on the forehead and somewhat higher (0.439) on the forearm.

DISCUSSION

Major differences in the pH of otherwise similar synthetic detergent preparations for skin cleansing have recently been demonstrated to influence both the skin surface pH and the bacterial micro-flora, both on the forehead and on the forearm of healthy individuals (2). The results of the present investigation support the previous findings. In addition, they show that even minor differences, of the order of a single pH unit, have a correspondingly marked differential effect on both skin surface pH and microflora. Although the differences are not especially remarkable when synthetic detergent preparations of pH 5.5 and 7.0 are used in a controlled fashion, as compared with the application of preparations of pH 5.5 and pH 8.5, the effects are in principle the same: using a less acidic synthetic detergent preparation makes the skin relatively more alkaline and thus favours propionibacterial growth.

High propionibacterial counts on the skin may be linked to adolescent acne (9). Moreover, even those who do not share this opinion consider the pH to be one of the ecological factors which might modulate the acne-inducing potential of propionibacteria (10). This has to be considered when planning the formulation of optimum preparations for cleansing normal human skin. Whatever the influence of the pH value of the skin-cleansing preparation on its cutaneous irritancy (4), one must not ignore the definite dependence of the behaviour of the skin pH and micro-flora in the long-term.

REFERENCES