

Effects of alkalinity of household dishwashing liquids on hand skin

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The objective of this research was to investigate the effects of alkaline pH conditions of dishwashing liquids on hand skin of Korean panelists after repeated exposure. A group of 30 persons with normal hands immersed their hands, for a total of 15 min a day for 4 days, into household cleansing solutions adjusted to pH 7.4, 10.0 and 10.8, respectively. The effects of alkalinity of household cleansing solutions on hand skin were evaluated by measuring overall and dry hand-skin grades, as well as the degrees of hand-skin hydration estimated before and after the repeated immersion exposures to the 3 test products. No statistically-significant difference ($p > 0.05$) was found among the parameters from the repeated immersion exposures to the test products. These findings indicate that increases of pH up to 10.8 of household cleansing solutions did not worsen either overall, dry hand-skin conditions or the level of hand-skin hydration.

Key words: alkalinity; pH; dishwashing liquid; hand skin; immersion; contact irritancy; microscopic visual assessment; corneometry. © Munksgaard, 2001.

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Detergents are classified into 4 groups: anionic, cationic, amphoteric, and non-ionic. These 4 groups are based on the hydrophilic and surfactant qualities they possess. Each group has characteristics that pertain to its main uses, irritancy and toxicity (1).

While detergent substances are important components of cleansing materials, their cleansing action may also result in skin irritancy. Methods for the evaluation of their irritant effect on the skin surface have been reviewed by means of the soap chamber test, and newer in vitro culture techniques (2, 3).

Several controversies have emerged about the effects of alkaline synthetic detergents on hand skin. Burckhardt (4) has stated that alkaline cleansing solutions remove the protective lipid bilayer, which is important in the defense of the skin against alkalis. Klauder & Gross (5) reported that prolonged exposure to alkaline washing agents resulted in delayed recovery of the skin. In contrast to the above reports, Pillsbury & Shaffer (6), employing both a patch test and a skin chamber technique, were unable to correlate alkalinity of soap with irritancy. Suskind & Rebello (7) have also advocated that repeated immersion in phosphate solutions of pH 10.0 does not affect normal hand skin or hand

dermatoses adversely. Because of these controversies, the ranges of pH of household dishwashing products are still legally restricted in Korea and Japan. According to the Korean and Japanese regulations, surfactants manufactured with non-potassium ester of fatty acid groups should be pH 6.0–8.0. These technical regulations could be obstacles in terms of development of new household dishwashing products.

Therefore, the main purpose of this research was to evaluate the effects of the immersion exposures to alkaline household cleansing solutions on normal hand skin, compared to those of neutral pH, in order to provide scientific evidence for the revision of regulations.

Materials and Methods

Materials

Household synthetic dishwashing liquids having pH 7.4, 10.0, 10.8 were manufactured by Procter & Gamble Korea, Inc. Binocular microscope (7×) (Meiji EMZ-TR Meiji Techno. Co., Japan) with lighting system was used for the evaluation of overall and dry hand skin grades. Using a Corneometer CM 825 (Japan Euro Tech., Japan), the degrees of hand skin hydration were measured.

Panel volunteers

30 panelists with normal hands were selected. The 30 panelists were grouped randomly into 6 groups. 2 different products, such as pH 7.4 and 10.0, pH 10.0 and 10.8, or pH 10.8 and 7.4, were exposed randomly to each panelist's right and left hand, respectively.

Exposure condition

All panelists were instructed to wear rubber gloves when they washed or cleaned at home during the study. The panelists were also reminded to refrain from using a lotion during the study. Exposure conditions to dishwashing solution for this test were determined tentatively based on the conventional pattern of usage of dishwashing solution in Korea and the principles of the direct application hand mildness test developed by P & G, Ltd., with slight modifications. The procedures for exposure to dishwashing solution were as follows.

(i) 2 l of tap water (20°C) was placed in a bucket. (ii) Sponge was placed in water and squeezed gently just to remove excess water from the sponge and then sponge was placed on countertop. (iii) Measured 5 ml of product was evenly applied to one side of the sponge. (iv) The panelists put both their hands into the bucket to get hands wet and then took hands out. Panelist squeezed the 2 sponges containing different pH of dishwashing solution with his/her left and right hand, respectively. One side of the sponge applied with 5 ml of the product was in direct contact with the panelist's palm for 5 s, which was enough time to lather over the palm, between the fingers and some of the dorsum. The panelist then held the sponge with the lather on the hand for the remainder of the min, palm-side up. (v) After the 1st min, the panelist repeated step 4, 1×, without placing hands in the bucket of water. (vi) After the 2nd min, the panelist dropped the sponge in the bucket of water and squeezed the sponge while in the water, to generate more lather as well as immerse hand in the product solution. Then the hand with the sponge was withdrawn from the solution and squeezed sponge for 5 s to generate enough lather to cover hand. After the panelist had generated enough lather, the sponge was dropped back into solution and hand remained out of solution for the remainder of the 3rd min. (vii) Step 6 was repeated 2×. (viii) After 5 min, the panelist rinsed hands in the same specific water conditions until the panelist felt solution and product were rinsed off completely and patted hands dry. (ix) Steps 2–8 were repeated 2 more times for a total of 15 min. This was repeated 4× on Monday through Thursday.

Measurement

Both hands of panelist were evaluated 1 h after step 9. An experienced clinical examiner was blinded and graded overall hand condition and degree of skin dryness of panelist's hands based on the grading scale shown in Tables 1, 2. The degree of hand skin hydration was measured by Corneometer CM 825 and expressed as capacitance. The instrumental measurements were conducted in a climate-controlled room at 20–25°C and 30–45% relative humidity. The panelist had occupied the room for at least 10 min before measurement was taken. The overall hand condition, hand skin dryness, and degree of hand skin hydration of all panelists were graded prior to the hand exposure on day 1 to obtain the initial grade value.

Data analysis

At the conclusion of the test, the overall hand skin condition, hand skin dryness and capacitance data were presented as means $\pm$ SD. Statistical significance was evaluated with ANOVA.

Results

The time-dependent data concerning grades for overall hand skin condition after immersion ex-

Table 1. Grading scale for overall hand condition

Grading scale	Feature
10	essentially perfect skin
9	fairly generalized powdery scales primarily on the dorsum
8	patchy to generalized small scales on the dorsum, and/or in the interdigital and volar digital crease area
7	generalized large lifted scales on the dorsum, interdigital web and palmar digital areas
6	localized to generalized large lifted scales over the entire dorsum, possibly with some shallow fissures.

Table 2. Dry skin grading scale (8).

Grading scale	Feature
0	no dry skin.
1	slightly lifted or powdery scales in only 1 area: on dorsum, palmar side or between the fingers
2	slightly lifted scales, covering 50–100% of the surface of 2 or more areas (dorsum, palmar or between fingers)
3	moderately lifted or powdery scales in only 1 area: on dorsum, palmar side or between fingers
4	moderately lifted scales, covering 50–100% of the surface of 2 or more areas (dorsum, palmar or between fingers)

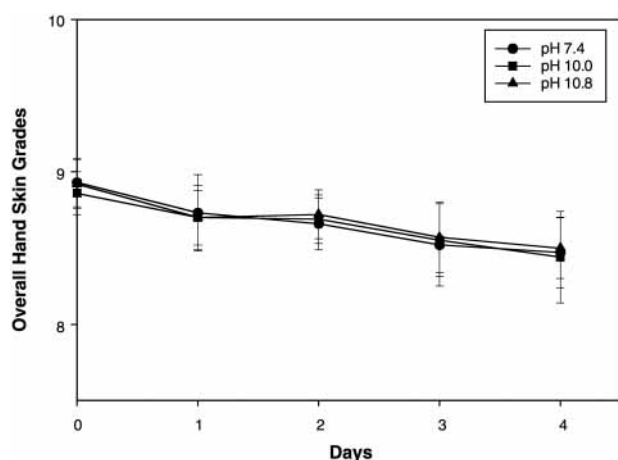


Fig. 1. Time-dependent effects of alkalinity of household cleansing solutions on overall hand skin condition.

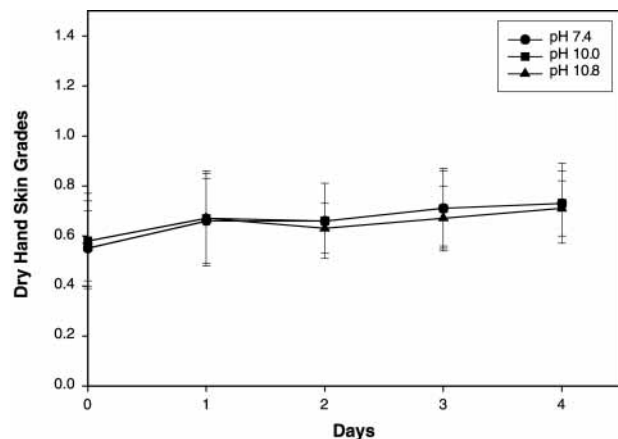


Fig. 2. Time-dependent effects of alkalinity of household cleansing solutions on dry hand skin condition.

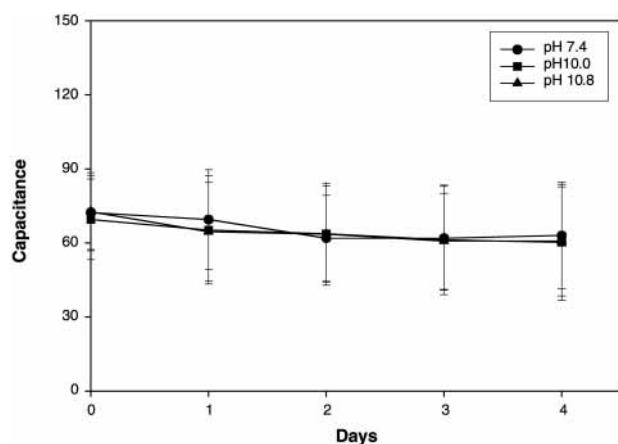


Fig. 3. Time-dependent effects of alkalinity of household cleansing solutions on the degree of hand skin hydration.

posures to cleansing solutions adjusted to pH 7.4, 10.0, and 10.8, respectively are shown in Fig. 1. There were no significant differences ($p>0.05$) among the overall hand skin grades of the 3 test products. This clinical observations indicate that alkaline household cleansing solutions at a range of pH up to 10.8, compared to neutral pH, did not affect the overall hand skin condition adversely.

The time-dependent data concerning grades for degree of dryness of hand skin after immersion exposures to cleansing solutions adjusted to pH 7.4, 10.0, and 10.8, respectively, are shown in Fig. 2. Similarly to Fig. 1, the 3 different-pH products did not show significant differences ($p>0.05$) as to the degree of dry hand skin conditions.

The time-dependent data concerning grades for the degrees of hand skin hydration after immersion exposures to cleansing solutions adjusted to pH 7.4, 10.0, and 10.8, respectively, are shown in Fig. 3. Also in terms of the degree of hand skin hydration, no statistically significant difference ($p>0.05$) was found among the 3 test products.

Discussions

These clinical observations indicate that alkaline household dishwashing liquid products at a range of pH up to 10.8, compared to neutral pH, did not affect the overall hand skin condition, degree of dryness of hand skin, and degree of hand skin hydration adversely. These clinical findings are consistent with the report of Suskind & Rebello (7). Van Ketel (9) reported that the pH of hand cleaners is not a useful parameter to predict their irritation of the hand.

In conclusion, our results suggest that an increase of pH up to 10.8 of household dishwashing liquid products has no significant effect in terms of overall hand skin condition, degree of dryness of hand skin, and degree of hand skin hydration.

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