Racial Differences in Corneocytes
A Comparison between Black, White and Oriental Skin

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It is well known that spontaneous desquamation and corneocyte size can reflect respectively stratum corneum cohesiveness and epidermal cell proliferation. The influence of skin pigmentation on these parameters has been investigated on the upper-out arm of black, white and oriental volunteers, using the detergent scrub method. We found no difference between race in corneocyte surface area, a mean size of 900 μm² agreeing closely with that generally encountered in Whites on the upper-out arm. By contrast, spontaneous desquamation is increased in black vis-à-vis white and oriental skin (factor 2.5, p < 0.001). Taking into account the importance of the intercellular cement for the cohesion between corneocytes, racial differences in epidermal lipid composition should be investigated.

(Accepted August 31, 1990.)
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Racial differences in physicochemical properties of the skin include, in blacks, increased resistance to stripping (1), increased electrical resistance (2) and increased skin lipid content (3), compared with white skin.

Corneocytes differ markedly from the keratinocytes that produce them, an obvious difference being the corneocyte’s disc-like shape, which presents a large surface area in the horizontal dimension. In humans, the corneocyte surface area is not constant; there are site (4, 5) and age (5, 6) differences. However, most such investigations were performed on Caucasians.

In the present study, non-invasive measurements including determination of the spontaneous desquamation (corneocyte count) and the corneocyte size have been compared in black, white and oriental volunteers.

MATERIAL AND METHOD
All subjects (18–25 per group) were American citizens and free from dermatological disorders. The black subjects were American negroes (33.5 ± 7.5 years), the oriental group comprised individuals of Chinese extraction only (26.5 ± 7.5 years) and the Caucasians were white Americans of European origin (31 ± 7 years). Prior to entering the study, the subjects read and signed the human experimentation consent form approved by the UCSF Committee on Human Research.

Corneocytes were collected from the upper outer arm. To standardize the sampling method, we built a ‘turbine engine’ based on the detergent scrub method described by McGinley et al. (7) to collect corneocytes in suspension. The apparatus, designed to minimize mechanical friction of the skin surface (8), consisted of a low-voltage revolving motor driving a helical wheel inside a cylindrical perspex chamber. The chamber was in contact with 3 cm² sampling area. The screw stirred 3 ml of detergent solution consisting of 0.05 M phosphate buffer, pH 7.9, containing 0.1% Triton X-100. The detergent solution was injected from a syringe via an opening in the chamber. The procedure took 1 min. The corneocyte suspension was then extracted with the syringe, which had been left in position.

The corneocyte suspension was stained with a mixture of fuchsine and gentian violet, and an aliquot placed in a hemacytometer. Automatic counting and measurement of the corneocyte surface area were performed using an image analyser (Quanimet 900, Cambridge Instruments, GB).

RESULTS
As shown in Table I there were no differences in corneocyte surface area between races. The numbers of corneocytes harvested with the turbine did not differ statistically between white and oriental volunteers. On the contrary, the spontaneous desquamation was increased in Blacks by a factor of about 2.5 (p < 0.001).

DISCUSSION
A mean size of 900 μm² agrees closely with that generally encountered on the upper-out arm (4, 5). There is an inverse correlation between epidermal cell proliferation and corneocyte size (9). Thus,
Table I. Racial differences in corneocytes

<table>
<thead>
<tr>
<th>Race</th>
<th>Mean surface area (μm² ± SE)</th>
<th>Number/cm² desquamating spontaneously</th>
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</thead>
<tbody>
<tr>
<td>Black</td>
<td>911 ± 20</td>
<td>26500 ± 4900</td>
</tr>
<tr>
<td>White</td>
<td>899 ± 22</td>
<td>11800 ± 1700</td>
</tr>
<tr>
<td>Oriental</td>
<td>909 ± 24</td>
<td>10400 ± 2100</td>
</tr>
</tbody>
</table>

in anatomical sites exposed to environmental factors (including sunlight), corneocytes are smaller (5). The upper-outer arm being partially protected by clothing, we do not know the possible relation between the degree of skin pigmentation and cell proliferation.

With ageing and UV light injury, the number of corneocytes harvested either by stripping or by using the detergent scrub method increases (6, 10). In Caucasians and for the anatomic site involved in this study, spontaneous desquamation of about 10,000 corneocytes per cm² skin surface area can be considered normal (8). On the other hand, the increased desquamation in Blacks seems not to fit the observation made by others, viz. increased resistance to stripping (1), increased electrical resistance (2), or increased TEWL (11). Additional work is needed to elucidate these apparent contradictions.

Differences in permeability between black and white human skin have been considered. However, agreement between investigations is rare. Thus, it has been shown that the in vivo skin penetration of diflorasone diacetate was the same in black and white subjects (12). By contrast, total absorption of dipryrinthone was, on average, 34% less in black than in white subjects (13), and the topical anesthetic EMLA was less effective in Blacks (14). In vitro, permeation of fluocinolone acetonide was greater through normal-appearing white skin than through black skin (excised from legs amputated for gangrene or tumours) (15). These observations could be related to greater density and the more compact stratum corneum in Blacks (1).

In Whites, it has been demonstrated that corneocyte size constitutes an important factor in the differences in permeability of the skin to water loss and percutaneous absorption of topically applied compounds (5). Recently, in vitro measurements have shown increased water loss in black vis-à-vis white skin (11). Moreover, it has been shown that the stratum corneum is of equal thickness in blacks and whites (16). Since corneocyte surface area does not differ statistically between black, white and oriental subjects, the differences observed in TEWL might depend more on the composition of the intercellular cement than on the volume of intercellular spaces. Whether there is a difference in epidermal lipid composition between races is a question we have undertaken to answer.

ACKNOWLEDGEMENT
We would like to thank Mrs C. Patouillet for her excellent technical assistance.

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Antibacterial and Antifungal Properties of Propylene Glycol, Hexylene Glycol, and 1,3-Butylene Glycol In vitro

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The antimicrobial properties of three glycols, propylene glycol, hexylene glycol, and 1,3-butylene glycol - against Candida albicans, Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus pyogenes, Streptococcus mitis, and E. coli were studied in vitro. Within 20 h, 10% and 30% hexylene glycol in fresh tryptic soya broth were able to kill all the microorganisms listed above. Five percent hexylene glycol showed some antimicrobial properties but the 1% agent had no effect. Thirty percent 1,3-butylene glycol and 30% propylene glycol were approximately as effective as 10% HG. The results speak in favour of using hexylene glycol in cosmetic and dermatological vehicles instead of propylene glycol and 1,3-butylene glycol.

(Accepted September 10, 1990.)


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Propylene glycol (PG) is widely used as a humectant, an antimicrobial agent, and as a solvent in many dermatological vehicles and in cosmetic skin care and hair care products (1-3). PG has an irritant effect on the skin, which is quite evident as increased water loss especially in atoxics (4), and it is also a sensitizer (4-7).

Hexylene (HG) and 1,3-butylene glycols (BG) are also used in cosmetic products in concentrations ranging from 0.1% to 50% as humectants, antimicrobial agents, and solvents (8). HG is used in at least one commercially available corticosteroid ointment (Legederm® ointment, Schering Corporation, Kenilworth, New Jersey, USA). Undiluted HG - but not a 25% solution - has been found to irritate rabbit skin (8-9). In repeated open application tests, HG did not irritate human skin, and under occlusion it was less irritating than PG (4). The moisturizing properties of PG and BG are similar (1, 10). They are nearly five times more hygroscopic than HG (1). BG is considered to be the best antimicrobial agent among these three glycols (11), HG being the second best (2). According to the CIT Panel, these glycols had low toxicity in acute, subchronic and chronic oral toxicity studies using a variety of animal species (9).

The aim of the present study was to investigate the antimicrobial properties of PG, HG, and BG against Candida albicans and certain pathogenic and non-pathogenic bacteria.

MATERIALS AND METHODS

Staphylococcus aureus (ATCC 29213), Staphylococcus epidermidis (ATCC 12228), Streptococcus pyogenes, Streptococcus mitis, E. coli (ATCC 25322) and Candida albicans were used as test organisms.

1,3-butylene glycol, pro anal. (Fluka Chemie AG, Switzerland), propylene glycol (Tamro Oy, Finland, Ph. Eur.) and hexylene glycol, puriss. (Fluka Chemie AG, Switzerland) were used as test substances. Bacto Tryptic Soy Broth (Difco Laboratories, Detroit, Michigan, USA) was used as the test medium. The minimal inhibitory concentration (MCC) was determined as follows: tubes with 10 ml of fresh tryptic soy broth with 0, 1, 5, 10 or 30 per cent of test substances (w/v) were inoculated with 100 μl of an overnight culture of the appropriate microorganism. The microbe concentra-

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