

# Letter to the Editor

## A quantitative index for area swelling of epidermal membrane

To the editor:

Area or "inplane" swelling of epidermal membrane has already been reported by several authors (1-3) and the potential value of this parameter to skin penetration and irritation cited (3). The most useful quantitative procedure described to date involves measurement of small squares of membrane on plastic screens, with a ruler calibrated in millimeters (3). Recently we have developed a technique which offers advantages, and we would like to offer it to dermatological research.

Epidermal membrane was separated from human abdominal cadaver skin (4) by the method of Kligman and Christophers (5), and after drying, cut into thin strips 0.5 to 0.6 cm wide and 4 to 5 cm long. Plastic tabs (cellulose acetate) are glued to each end of the membrane with Duco<sup>®</sup> cement sandwiching both ends between two tabs (Figure 1). The membrane is hung by one end and the length between the tabs measured before and after treatment. This measurement we call the crosswise length, because the direction along the membrane length is across the abdomen or perpendicular to the body axis. We currently measure this parameter with a

cathetometer calibrated in tenths of a millimeter, however, an even more sensitive device could be employed.

Changes in the swelling of membrane lengths cut across the body axis have been compared to those at right angles to it, and these data are summarized in Table I. Statistical analysis shows highly signifi-

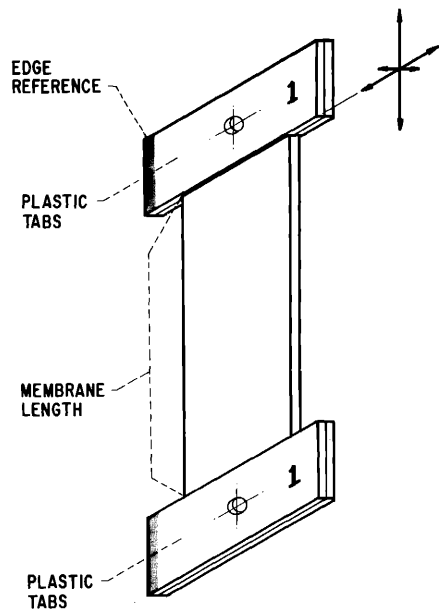


Figure 1. Schematic of membrane strip for swelling measurement.

**Table I**  
Direction of Membrane Cut<sup>1</sup>

Treatments	Length Ratio: Treated/ Dry	
	Crosswise Length	Axial Length
Water (24 hours)	1.09	1.08
2% Sodium Lauryl Sulfate (1-hr-40°C)	1.35	1.32

<sup>1</sup>Each value is a mean of 6 replicas and all pieces of skin from the same donor.

cant treatment effects, with no significant difference between the two directions of cut, and no significant direction-treatment interactions. Therefore, this single swelling measurement is an index of area swelling, which may be obtained simply by squaring the change in membrane length.

This technique may be applied to purified or impure stratum corneum, but the method of membrane preparation should be constant because it can influence swelling results. Measurements should be taken with the membrane hanging in air rather than in solution to eliminate buoyancy effects. We recommend marking one edge of each plastic tab with permanent ink as a reference, and measurements always taken at the reference corner where membrane emerges from the tab. With treatments that cause extensive swelling, membranes usually

twist, and the amount of twist seems to relate to the amount of swelling, therefore, the true swelling lengths are actually greater than the measured values; nevertheless, this is a highly reproducible measurement.

We are currently studying this method by examining effects of surfactant structure on area swelling of human epidermal membrane, and comparing the swelling properties of stratum corneum with human hair and other keratins.

## REFERENCES

- (1) E. K. Von Gotte, Der einfluss von kolloidelektrolyten auf die quellung isolierter epidermis, *Kolloid Z.*, **117** 42-7 (1950).
- (2) R. Scheuplein and L. Ross, Effects of surfactants and solvents on the permeability of epidermis, *J. Soc. Cosmet. Chem.*, **21** 853-73 (1970).
- (3) E. J. Putterman, N. Wolejsza, M. A. Wolfram and K. Laden, The effect of detergents on the swelling of stratum corneum, *J. Soc. Cosmet. Chem.*, **28**, 521-532 (1977).
- (4) Human abdominal cadaver skin was obtained from Dr. A. M. Kligman Ivy Research Laboratories Department of Dermatology. University of Pennsylvania, Philadelphia, Pa.
- (5) A. M. Kligman and E. Christophers, Preparation of isolated sheets of human stratum corneum, *Arch. Dermatol.*, **88**, 702-5 (1963).

*K. Fernee and C. R. Robbins*  
*Colgate Palmolive Research*  
*Center*  
*909 River Road*  
*Piscataway, NJ 08854*