

WATER VAPOUR SORPTION AND DESORPTION IN HUMAN STRATUM CORNEUM IN-VITRO: EFFECT OF SODIUM CHLORIDE AND UREA

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A previous study (Swanbeck, 1972) of urea and sodium chloride containing dermatological products suggested that these salts increase the water binding capacity of the stratum corneum (s.c.) in a synergistic fashion. To investigate this claim we developed an apparatus for monitoring sorption and desorption of water vapour by skin in vitro. Strips of dried human abdominal s.c. were suspended in a microbalance at $32 \pm 0.5^\circ\text{C}$. Air was passed through water or Drierite, the streams were mixed at a constant flow rate and hence a range of relative humidities (R.H.) could be obtained (termed flow system). In addition, these R.H.s could be attained using salt solutions (stationary system). Water vapour sorption and desorption profiles were recorded over 24 h and initial diffusion coefficients D_i and other parameters were calculated Scheuplein (1967). Selected data are presented in Table 1.

$$D_i = \frac{\pi l^2}{16} \frac{m^2}{M_{\infty}^2} \quad \text{where} \quad \begin{array}{l} l = \text{s.c. thickness } (\mu\text{m}) \\ m = \text{initial slope (sorption or desorption) vs. time (mg hr}^{-\frac{1}{2}}) \\ M_{\infty} = \text{maximum water uptake/loss in 24 h (mg)} \end{array}$$

The effect of treating the skin for 12 h with 12% w/v sodium chloride, 12% w/v urea and a combination of both was also studied.

The profiles differed between the flow and stationary systems, a fact not reported previously. At 24 h, the water uptake in the flow system had reached a maximum, while in the stationary it was still increasing and was already approximately four times higher. Initial absorption diffusion coefficients were similar and independent of the final R.H. attained and the system used. However, desorption coefficients were much higher ($p = 0.05$) in the stationary system. All skin treatments increased water uptake (Table 2).

Table 1. Water sorption and desorption data

| RH Value % | Initial Skin Weight (mg) | M_{∞} (mg) | Slope m (mg hr ^{-1/2}) and correlation coefficient | D_i (cm ² hr ⁻¹) x 10 ⁺⁷ |
|------------|--------------------------|-------------------|--|--|
| 0-91 FLOW | 9.620 | 0.411 | 0.436 (0.990) | 2.21 |
| 91-0 FLOW | 10.027 | 0.480 | 0.304 (0.990) | 1.77 |
| 0-91 STAT | 9.078 | 1.689 | 1.55 (0.999) | 1.65 |
| 91-0 STAT | 10.532 | 1.617 | 2.47 (0.990) | 10.3 |

Table 2. Ratio increases in water uptake/loss (24 h), treated: control s.c. samples

| Skin Sample 1 | Treatment | Relative Humidity % | |
|---------------|-----------|---------------------|------|
| | | 0-91 | 91-0 |
| Flow | NaCl | 1.3 | 1.2 |
| | Urea | 3.3 | 3.0 |
| | NaCl+Urea | 3.2 | 3.2 |
| Stationary | NaCl | 1.2 | 1.5 |
| | Urea | 1.4 | 1.6 |
| | NaCl+Urea | 2.2 | 2.3 |

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1. Swanbeck, G.P.E. (1972) U.K. Patent 1411432
2. Scheuplein R.J. (1967) J. Invest. Derm. 48 (1), 79-88