

ORIGINAL CONTRIBUTIONS

SURFACE pH OF NORMAL SKIN

A B Gupta, T P Tripathi and B Haldar

The skin surface pH of 55 brown-skinned individuals (Indians) comprising of 30 males and 25 females in the age range 12-58 years has been measured at the forehead (FH) and the back of the wrist (BW). The mean values of skin pH at FH and BW are 5.51 ± 0.32 and 5.56 ± 0.40 respectively for male. The corresponding female values are 5.73 ± 0.32 and 5.84 ± 0.28 . Statistical analysis of the data shows that (i) the dependence of skin surface pH on age is not significant, (ii) the male skin is slightly, but significantly more acidic than the female one, (iii) the mean values of skin pH at forehead and at back of the wrist do not differ significantly for male; the difference however is significant for female at 5% level, (iv) there exists a significant positive correlation ($r = 0.77$ for male and $r = 0.71$ for female) between the pH's of the forehead (x_1) and the back of the wrist (x_2). The regression equations of x_2 on x_1 are: $x_2 = 2.13 + 0.61x_1$ for male and $x_2 = 1.05 + 0.80x_1$ for female.

Key words: pH, Normal skin.

Skin surface pH results from water-soluble substances in the corneal layer and the secretion of sebum as well as CO_2 . An acid mantle exists in the skin and this acid contributes to increased bactericidal and fungicidal activity. Pathologic cases apart, a long-term exposure of skin to wrong cosmetics, soaps and contact of chemicals may lead to an early ageing and even a permanent damage to skin. A permanent high pH reduces its protective functions. Skin surface pH measurement is thus of importance especially when the skin is exposed to severe environmental stresses.

While skin pH data for white people are available,^{1,2} no work is so far reported on the Indian skin. It was in this context that the study was undertaken.

Materials and Methods

Measurement of the skin surface pH was carried out using a compact, battery-operated pH-meter: SMT pH-90, fitted with a specialised microelectrode suitable for measuring skin surface pH. It is easy to handle and offers a quick, reliable and reproducible reading. The measuring and the reference electrodes have been coordinated into a handy, single measuring probe that separates the inner fluid from the fluid to be investigated by a glass membrane. The reference electrode is fitted around the probe and allows the ions to pass through, thus forming a connection with fluid to be tested on the skin surface. The shape of the electrode is well suited for the measurement. Its face, the glass membrane, is a planed disc and thus makes exact contact with the skin surface. The electrode is first calibrated with two buffer solutions of known and stable values: 6.9 and 4.0, and this makes the device ready for the pH measurement.

Fifty five brown-skinned Indians (30 males

From the Physics Unit and Stat-Math Division, Indian Statistical Institute, Calcutta and Calcutta Skin Institute, Calcutta-700054, India.

Address correspondence to: Dr. A.B. Gupta, Physics Unit, Indian Statistical Institute, 203 B.T. Road, Calcutta-700 035, India.

and 25 females) in the age range 12-58 years and examined clinically for normal skin, constituted the sample population. Prior to measurement, it was ensured that the subject was free for a period of at least 6 previous hours from any contact with cosmetics, soaps and other similar agents and had no extreme perspiration in the immediate past. For otherwise, the natural condition of the skin would be altered.

The forehead and the back of the wrist were the two preferred sites. At each site three readings were taken and their average value computed as the pH for the site concerned. The electrode was rinsed in clean distilled water before any new measurement. The surplus water from the face of the membrane was removed by laterally shaking the electrode to keep it just damped. Larger amounts of water may influence or delay the constant reading. The face of the electrode should always point downward but not necessarily vertically downward.

The experiments were conducted at an ambient temperature 24-28°C and a relative humidity 50-55%.

Results

The experimental findings for the skin surface pH at the two selected sites are summarised in table I.

The age-ranges in our sample were 17-55 years with a mean of 36.43 ± 10.21 for male and 12-58 years with a mean of 37.04 ± 10.43 for female. The spreads of the pH-values at the

forehead were 4.6-6.4 and 5.2-6.2 for male and female respectively. The corresponding spreads at the wrist were 4.5-6.4 and 5.4-6.4. While for most of the female individuals, the pH at the wrist was greater than that at forehead, for about one-third of the male individuals they were equal and for another one-third the forehead pH was greater than wrist-pH. The dispersion of the individual pH-readings from the mean were quite small resulting in small standard deviations.

Using paired t-test, the difference between the mean pH's at forehead and wrist is not found significant ($p < 0.05$) for male; for female however the difference is significant only at 5% level. Using F-test³ for multiple correlation between age and pH's at the two sites, it is found that the age does not significantly correlate with pH either at forehead or at wrist. Using multivariate analysis,³ the mean pH's for male at the two sites were compared with those for female and the male skin appears to be slightly but significantly ($p < 0.01$) more acidic. A significant positive correlation ($r = 0.76$ for male and $r = 0.71$ for female) exists between the pH of forehead, (pH_f) and that of wrist, (pH_w), the regression equations being

$$(pH_f) = 2.13 + 0.61(pH_w) \dots \text{male}$$

$$(pH_f) = 1.05 + 0.80(pH_w) \dots \text{female}$$

Comments

The present study was undertaken in the context of non-availability of pH-data of Indian skin. It is thus worthwhile to compare our results with those of others in the field. Schmidt² studied the skin pH of dorsa of forearms of white adult men and women and obtained an overall average 5.46 with a spread of 4.5-6.0 in men and 5.0-6.0 in women. Blank⁴ determined skin pH in white normal males, females and children and found a value ranging between 4-7 but mostly within 4.4-5.6. He also observed that (i) female average is 0.5 unit higher than male average, and (ii) adult male

Table I

Sex	Mean (\pm SD) pH of skin surface at	
	Forehead	Wrist
Male	5.51 \pm 0.32	5.56 \pm 0.40
Female	5.73 \pm 0.32	5.84 \pm 0.28

SD = standard deviation

pH is lower than prepubertal boys but adult female pH is almost identical with prepubertal girls. Draize⁵ working with 51 white males, 52 white females and 25 negro males at various sites (back of hand, forehead, cheek etc.) also found results similar to those of Blank. He obtained averages 4.85 (95% between 4.2-5.8) for white male, 5.50 (95% between 4.8-6.2) for white female and 5.21 (95% between 4.4-6.0) for negro male. Very little regional differences were obtained. Our findings show the overall average of skin pH of Indian male and female as 5.54 and 5.78 respectively, with 95% confidence limits between 5.40-5.66 for male and 5.66-5.90 for female. The skin pH of Indian male is thus higher than that of white and negro males but almost identical with that of white females. The skin pH of Indian female however is higher than all the three groups. The two sites at which we restricted our study show no regional difference in pH for male but a difference in 95% cases for female. In agreement with Blank, Draize and others, we found that among the Indians also the male skin is slightly but significantly more acidic. The matter is somewhat controversial¹ for many workers did not find any sex difference in skin pH. The spread in our pH-values also more or less agree with that of other workers. Zlotogorski et al⁶ recently carried out pH measurement on the forehead of more than 400 Jewish men and women aged 18-95 in Jerusalem and found that 95% of the people had a pH 3.8-5.8, the older ones showing a higher pH. Neither in our work nor elsewhere, to our knowledge, normal skin pH below 4 has been recorded. Although the age difference in pH was reported by many,^{4, 6} we did not get any and this may be due to our restricted study. This point also however is being debated by others.¹

Soaps, cosmetics etc might change the skin pH, depending on their starting pH and buf-

fering capacity. On using a normal commercial soap, the skin returns to its original pH within 1-3 hours. If the product changes the skin pH for a longer time, a chronic study is indicated to show lack of undesirable side effects, for statistical correlation is recently reported¹ between high chronic pH and lack of normal viscoelasticity of skin. The skin pH so long has been associated with eccrine sweating and protein isoelectric point. But the skin surface pH of affected areas of persons suffering from total anhidrosis is not different from their normal area of normal values and also scopolamine has no effect on skin pH. Sweat cannot thus be the primary source of skin acidity.¹ To establish the biological origin of skin acidity, a renewed interest has developed in the study of skin surface pH.

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