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Abstracts

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Review Article

Methodology to improve epidermal barrier homeostasis: How to accelerate the barrier recovery?

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Good water-impermeable barrier function is vital for healthy skin. Abnormality of the barrier function is observed in a variety of skin diseases, such as atopic dermatitis, psoriasis and contact dermatitis. Moreover, repeated barrier disruption induces epidermal hyperplasia and inflammation. On the other hand, acceleration of the barrier recovery prevents epidermal hyperplasia induced by barrier disruption in a dry environment. Thus, methods to improve the barrier function are very important for clinical dermatology. Recently, we have been searching for new reagents and/or new materials to improve barrier homeostasis. In this review, I will describe our recent findings and show how they provide the basis for a new perspective for clinical dermatology.

Quartz plates for determining sun protection *in vitro* and testing photostability of commercial sunscreens

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Testing plate made of optical quartz has been developed for the purpose of determination of sun protection factor $(SPF)_{in\ vitro}$ by the method of diffusion transmission spectroscopy; the plates were coarsened by sanding and grinding to surface roughness values (Ra) of 18 μm. The plate was coated with a film of sunscreen by an application of 2 mg cm^{-2} as that used for determination of $SPF_{in\ vivo}$ by the COLIPA method. The transmission values measured were converted into the $SPF_{in\ vitro}$ and the protection factor in ultraviolet A light, $UVAPF_{in\ vitro}$. The testing plate was tested with commercial sunscreens. The found values of $SPF_{in\ vitro}$ fit well with the values determined by means of the COLIPA method in vivo. The plates coated with sunscreen film were irradiated with light simulating the sun radiation. The values of protection factors obtained before and after irradiation were compared, and the differences were used for estimation of photostability of the UV filters included.

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Speculations on the molecular structure of eumelanin

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Eumelanin is the polymeric black pigment commonly found in hair and skin. Its chemical intractability, to all but vigorous oxidizing agents, has hindered satisfactory understanding of its molecular structure. It is well-established that the immediate precursor to polymerization, indole-5,6-quinone (IQ), is biosynthesized from the amino acid tyrosine. Current views are that the polymer consists of single bond connections between random indole and degraded indole units. In this paper, an alternative chemical scheme for the polymerization of IQ is proposed based upon the original suggestion by Horner in 1949 that a Diels-Alder (D–A) reaction might be involved. The proposed basic chemical scheme for eumelanin formation is that D–A addition occurs specifically between the 2- and 3-positions of one IQ molecule and the 7- and 4- positions respectively of a second IQ molecule, that the ensuing diketo bridge is oxidized to carboxyl groups and that, by decarboxylation and aromatization, a fused indole dimer is produced. It is envisaged that, by further D–A addition of more IQ molecules, oligomers of greater molecular mass are produced. Calculations based on published bond lengths and angles for the indole nucleus show that oligomeric units containing a total of up to 11 fused indoles could be packed into a flat circular disc of 20 Å diameter. The discs of the extensively conjugated polymer are envisaged to be stacked above each other by π–π interaction and with a spacing of 3.4 Å to produce cylindrical units, the mass density of which is calculated to be 1.54 gm cm^{-3}; approximating with actual physical measurements. The size and shape of the predicted cylinders are in concordance with those observed in atomic force microscope investigations of eumelanin proto-particles. The model is also in agreement with published experimental data that 2/3rds of the carbon dioxide liberated during eumelanin formation derives from positions 5- and 6- of the IQ molecule.

Closed-chamber transepidermal water loss measurement: microclimate, calibration and performance

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The importance of transepidermal water loss (TEWL) as a measure of the skin barrier is well recognized. Currently, the open-chamber method is dominant, but it is increasingly challenged by newer closed-chamber technologies. Whilst there is familiarity with open-chamber characteristics, there is uncertainty about the capabilities of the challengers. The main issues are related to how microclimate affects TEWL measurements. The aim of this paper is to provide a framework for understanding the effects of microclimate on TEWL measurement. Part of the problem is that TEWL measurement is indirect. TEWL is the diffusion of condensed water through the stratum corneum (SC), whereas TEWL methods measure water vapour flux in the air above the SC. This vapour flux depends on (i) the rate of supply of water to the skin surface and (ii) the rate of evaporation of water from the skin surface. Rate (i) is a skin property (TEWL), rate (ii) is a microclimate property. The controlling rate for the combined process is the lower of the above two rates. Therefore, TEWL instruments measure TEWL only when TEWL is the rate-limiting process. Another problem is that SC barrier property and SC hydration are affected by the microclimate adjacent to the skin surface. This is discussed insofar as it affects the measurement of TEWL. The conclusion is that such changes occur on a timescale that is long compared with TEWL measurement times. An important aspect of TEWL measurement is calibration. We present an analysis of the traditional wet-cup method and a new droplet method that is traceable and has been independently verified by a standards laboratory. Finally, we review performance indicators of commercial closed-chamber instruments with reference to open-chamber instruments. The main findings are that TEWL readings correlate well, but there are significant differences in the other aspects of performance.

Arbutin determination in medicinal plants and creams

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A simple flow injection (FI) manifold with spectrophotometric detection was fabricated and tested for arbutin determination. It is based on the measurement of a red-coloured product at 514 nm formed by the complexation reaction between arbutin and 4-aminoantipyrine (4-AP) in the presence of hexacyanoferrate (III) in an alkaline medium. On injecting 300 µL standard solutions at various concentrations of arbutin into the FI system under optimum conditions, a linear calibration graph over the range of 1.0–30.0 µg mL^{-1} arbutin was established. It is expressed by the regression equation $y = 0.2188 \pm 0.0036x + 0.1019 \pm 0.0366$ ($r^2 = 0.9990$, $n = 5$). The detection limit (3σ) and the limit of quantitation (10σ) were 0.04 µg mL^{-1} and 0.13 µg mL^{-1}, respectively. The RSD of intraday and interday precisions

were found to be 1.2–1.4% and 1.7–2.7%, respectively. The method was successfully applied in the determination of arbutin in four selected fruits and three commercial whitening cream extracts with the mean recoveries of the added arbutin over the range of 96.2–99.0%. No interference effects from some common excipients used in commercial whitening creams were observed. The method is simple, rapid, selective, accurate, reproducible and relatively inexpensive.

Development of clay liquid detergent for Islamic cleansing and the stability study

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Clay liquid detergents (CLDs) were developed for cleansing religiously-prohibited dirt ('najis') according to Islamic law. Four types of clay were selected: marl, kaolin, bentonite and veegum. After product development trials, five CLD formulations with varying combinations of clays were qualified for stability testing. Three exaggerated temperature conditions were considered: 4°C for 24 h, 50°C for 7 days, and 40°C for 1 month. The CLDs were also evaluated at 30, 60 and 90 days after production, while being stored at room temperature (RT30, RT60 and RT90). Physical and chemical characteristics including pH, colour, viscosity, surface tension, foam tests and sensory liking scores were evaluated. Our results showed that the kaolin-based formula, F2, had an optimal pH (closest to skin pH) of 5.08. The other formulas ranged from pH 6 to 8. Colour shades of the CLDs ranged from white, to creamy white, to mildly greenish-white. The foaming properties of the CLDs, the means ± SD of foam heights at 0 and 5 min, using the Ross–Miles test, were 19.13 ± 0.25 to 20.88 ± 0.45 cm at RT90 and were comparable with those of commercial detergents. Foam stability of all CLDs was high, as shown from the foam heights between 0 and 5 min being not significantly different ($P > 0.05$). The surface tensions, means ± SD, of CLD solutions were between 27.94 ± 0.08 and 28.72 ± 0.04 mN m^{-1}, which were slightly better than the surface tension of 29.08 ± 0.04 mN m^{-1} for sodium lauryl sulphate. There was a weak negative relationship between surface activity and foam height, based on the pooled data of the CLDs ($R^2 = 0.209$, $P < 0.01$). The viscosity of four CLDs ranged from 16 317 to 49 036 mPa s. In conclusion, CLDs can be formulated with good stability. F2 (kaolin-based, with a white, creamy texture) was the best CLD formula. It had the highest surface activity, moderate lathering and pleasant physical appearance.