Silt is sediment formed in estuaries and coastal regions along the seashore. It occurs along the entire North Sea coast and it is used in skin therapy. A single mud treatment induces normalization of stratum corneum hydration, transepidermal water loss, skin surface pH and sebum content (1). Mud therapy has been used successfully in several inflammatory skin diseases, such as psoriasis vulgaris (2), atopic dermatitis (3), acne vulgaris (4) and skin ulcers (5). The aim of this study was to elucidate possible anti-inflammatory effects of sea silt and sea salt-containing topical formulations on human skin in vivo.

MATERIALS AND METHODS

Different topical formulations containing sea silt essences and sea salt were tested: La mer MED Sea-salt cream® (SSC, 7.5% sea silt, 10% sea salt), La mer MED sea salt lotion® (SSL, 5% sea silt, 3.5% sea salt) and La mer MED fat cream® (FC, 7.5% sea silt, 0.5% sea salt) (La mer, Cuxhaven, Germany). The silt extract in these formulations contains approximately 0.6% fatty acids (hexadecanoic acid, hexadecenoic acid, eicosapentaenoic acid, octadecatrienoic acid and eicosatetraenoic acid) and 0.3% sulphur. All formulations (except for SSL) also contain 1% hydrolysed enteromorpha compressa extract and up to 5% hydrogenated vegetable and palm kernel oil, which contains 82% saturated and 18% unsaturated fatty acids (i.e. oleic acid and linoleic acid). Twenty healthy volunteers aged 22–29 years were tested for tolerability and efficacy of sea silt formulations after approval by the local ethics committee. To test tolerability, ten healthy volunteers (age range 22–27 years) applied SSC to one-half of the body’s skin surface (either left or right). In addition, five volunteers applied SSL to one side of the body and FC to the other half; the head and back were left as untreated control areas. After 2 h, skin areas on the left and right upper and lower arms, legs and back were measured for skin pH, transepidermal water loss (TEWL) (Dermat Unit SSC3 and Tewameter TM300, both from Courage & Khazaka, Cologne, Germany) and skin colour (Chromameter CR-300, Minolta, Osaka, Japan) (6, 7). Measurements were repeated 0.5 h and 24 h after irradiation with a minimal erythematous dose (MED) of ultraviolet A (UVA) and ultraviolet B (UVB) (Waldmann UV 3003K, Herbert Waldmann GmbH & Co. KG, Villingen-Schwenningen, Germany). To test anti-inflammatory efficacy, well-defined areas of 9 cm² were exposed to ultraviolet A/ultraviolet B (UVA/UVB) irradiation (mean of 10 volunteers with standard error (SE), significance (Wilcoxon signed-rank test) and PGE2 prostaglandins using sensitive gas chromatography-mass spectrometry and negative ion chemical ionization, as described previously (8).

RESULTS

All test products were well-tolerated without any side-effects or increase in skin pigmentation throughout the study (data not shown). All preparations prevented a decrease in pH and an increase in transepidermal water loss.
water loss (TEWL) observed at 24 h post-UVA/UVB in untreated skin (Table I). Furthermore, FC and SSL strongly decreased TEWL and all sea silt preparations inhibited increase in skin erythema 24 h post-UV irradiation compared with untreated skin (Table I). Microdialysis showed lower mean values of AUC for 8-iso-PGF$_{2\alpha}$ and total F2-isoprostanes, obtained from dialysates of treated skin areas in all 10 volunteers with any treatment compared with BC (Table II). Treatment with DG resulted in lower amounts of mean AUC for all markers, whereas treatment with SSL resulted in lower amounts of mean AUC for 9α,11α-PGF$_{2\alpha}$ in all 10 volunteers tested. In six volunteers, we were able to analyse changes in skin darkness and erythema of treated skin areas at the end of microdialysis 36 h after UVB irradiation (Table III). There was a significant decrease in skin redness and darkness at 36 h for untreated non-irradiated skin and skin treated with SSC, SSL and DG, but not for FC compared with skin areas treated with BC as a negative control (Table III). When comparing these results with the mean values of AUC for 5- and 8-iso-PGF$_{2\alpha}$, total F2-isoprostanes and 9α,11α-PGF$_{2\alpha}$ and PGE2 prostaglandins from the microdialysates of the same volunteers, decreases were observed in untreated non-irradiated skin and skin treated with the same topical formulations; that is, SSL, SSC and DG.

Table III. Skin darkness (black = 0, white = 100) and erythema levels of treated skin areas 36 h after ultraviolet B (UVB) irradiation (at the end of microdialysis) in 6 volunteers (mean values in pg/ml · h ± standard error (SE))

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Skin darkness</th>
<th>Erythema (values &gt; 0 indicates increasing skin erythema)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base cream</td>
<td>62.70 ± 0.24</td>
<td>10.57 ± 0.21</td>
</tr>
<tr>
<td>Fat cream</td>
<td>64.27 ± 0.34</td>
<td>10.15 ± 0.29 (p = 0.29)</td>
</tr>
<tr>
<td>Sea salt cream</td>
<td>65.19 ± 0.24</td>
<td>9.22 ± 0.43 (p = 0.04*)</td>
</tr>
<tr>
<td>Sea salt lotion</td>
<td>64.00 ± 0.31</td>
<td>9.61 ± 0.42 (p &lt; 0.01**)</td>
</tr>
<tr>
<td>Diclofenac gel</td>
<td>64.65 ± 0.21</td>
<td>9.43 ± 0.34 (p &lt; 0.01**)</td>
</tr>
<tr>
<td>Untreated, non-irradiated skin</td>
<td>67.62 ± 0.08</td>
<td>6.88 ± 0.11 (p &lt; 0.01**)</td>
</tr>
</tbody>
</table>

*p-values < 0.05 indicate significance compared with base cream, **p-values < 0.01 indicate strong significance.

DISCUSSION

We used cutaneous microdialysis to detect differences in prostanoid levels of irradiated and treated skin. However, microdialysis is an invasive method (10), leading to release of prostanoids. This, together with the small number of patients, may have prevented the detection of significant differences between treatment areas, although sufficient time was allowed for tissue recovery and equilibration as determined in previous experiments (8, 11). Sea silt extract contains various active substances from sea silt, such as unsaturated fatty acids, sulphur and algae. These ingredients could contribute to sea silt’s anti-inflammatory efficacy, which are known to derive from omega-3 and omega-6 fatty acids (12). Omega fatty acids inhibit the formation of pro-inflammatory eicosanoids, but can also form potent anti-inflammatory lipid mediators, such as resolvins and protectins, suppress NFκB activity and reduce the production of pro-inflammatory enzymes and cytokines (COX-2, TNF-α, IL-1β) (13). We were able to demonstrate that all tested sea silt- and sea salt-containing topical formulations suppressed the UVB-provoked release of 8-iso PGF$_{2\alpha}$, which is a well-known marker of oxidative stress. Furthermore, skin redness and skin darkening was significantly decreased by sea silt- and sea salt-containing formulations (more for lotion than for cream). However, the effect was lower than that observed following treatment with oral diclofenac, a known inhibitor of COX-1 and -2. FC, the only formulation that did not contain sea salt, failed to exert a depressive effect on prostanoids 9α,11α-PGF$_{2\alpha}$, PGE2 and 5-iso-PGF$_{2\alpha}$.

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Conflict of interest: Sven R Quist received financial support from La mer cosmetics AG for materials (microdialysis catheters and topical formulations) in order to conduct this trial. No further conflict of interest by any of the author is reported.

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1. Comacchi C, Hercogova J. A single mud treatment induces normalization of stratum corneum hydration, transepidermal


