The effect of a humectant emollient cream containing 5% urea compared to a non-humectant emollient on the skin barrier in older people with dry skin

S. G. Dabney,1,2 K. Brown,1 T. Higgins-Bayliss,1 J. Chilcote,1 M. J. Cork1
1The Academic Unit of Dermatology Research, Department of Infection and Immunity, The University of Sheffield Medical School, Sheffield, UK; 2The Pediatric Dermatology Clinic, Sheffield Children’s Hospital, Sheffield, UK. *Corresponding Author: s.dabney@sheffield.ac.uk

ABSTRACT

Worldwide the prevalence of xerosis increases with advancing age, affecting up to 75% of older people.1 The development of xerotic conditions, such as atopic dermatitis (AD), xerotic eczema and senile xerosis is associated with a skin barrier defect (Figure 1).2 This defect is characterized by reduced natural moisturising factor (NMF; comprising sodium pyrophosphate, citric acid, urea and lactic acid etc) and abnormal levels of intercellular lipids (cholesterol, ceramides and free fatty acids) in the stratum corneum (SC).3,4 As we age the integrity of the skin barrier declines, and recovery following disruption shows increasing skin susceptibility to negative environmental factors.5 Emollients are widely used to treat xerosis, however there is limited mechanistic evidence of their effects on the skin barrier.6-9 Emollients are widely used to treat xerosis, however there is limited mechanistic evidence of their effects on the skin barrier.6-9

INTRODUCTION

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METHODS

21 volunteers over the age of 60 with senescent dry skin were recruited (mean age 64.0 years, range 50-82 years). Each volunteer applied two non-tape-stripped (NTS) of humectant emollient Balneum Ultra (Balneum Ultra Ltd., UK) to one forearm and 2 NTS of non-humectant emollient Aquacream (Cream, Thornton & Lowe) to the other forearm in a randomized double-blind design. Measurements were taken the day after and before (12-20 hour period) the treatment period the following parameters:

- Skin barrier function was determined by measuring transepidermal water loss (TEWL) using an Aqualab TEWL machine (Decagon, UK).
- SC integrity was determined using tape-stripping in conjunction with FTR spectra.
- Skin-surface pH and SC hydration were measured using a Skin-pH meter and Corneometer respectively (C&K, Germany).
- Caseinolytic protease activity was determined for samples of SC removed by tape-stripping based on a previously published method.
- FTR spectra were collected using a silver halide film-optic probe embedded in a Nicolet 610 FTIR spectrometer (Thermo Scientific, Inc.) equipped with a cold MCT detector and purged with dry N2. 32 scans were collected for each measurement at 4 µm resolution. Spectral analysis was performed using Omnic 6.0 software (Thermo Electron Corp., Madison, USA).
- The levels of PCA in samples collected as tape-strips (6-12 steps) were quantified as previously described.8
- Lactate samples were collected using a pre-wetted cotton-swab, and the concentration determined by fluorometric L-lactate assay (Roche, Indianapolis, IN).
- To assess the effect of the humectant emollient throughout the thickness of the SC, the healthy participants detailed above applied 2 NTS to one forearm, and 2 NTS per tape-stripping was performed in conjunction with FTR measurements (as described above) to assess the molecular changes down through the depth of the SC.

RESULTS

1. Treatment with the humectant emollient for 28 days preserves normal skin barrier function in older people with dry skin

2. Treatment with the humectant emollient improved SC integrity compared to untreated skin and skin treated with the non-humectant emollient

3. Reduced SC integrity following treatment with the non-humectant emollient is associated with elevated skin-surface pH and degradatory protease activity

4. The humectant emollient significantly hydrated the skin for more than 12 hours after cessation of treatment

REFERENCES


CONCLUSIONS

- The humectant emollient significantly hydrated the skin of older people with dry skin to a greater extent and for a longer period of time compared to the non-humectant emollient.
- The humectant emollient significantly elevated SC NMF levels exogenously and endogenously, putatively via increased filaggrin expression.
- Treatment with the humectant emollient for 28 days preserved skin barrier function and improved SC integrity in older people, indicative of skin barrier repair properties.
- This highlights the significant difference in effects of emollients on the skin barrier, and their potential to treat dry skin conditions.

Figure 1: Skin barrier condition changes with age

Figure 2: TEWL before and after 28-days treatment with the humectant (HE) and non-humectant (Non-HE) emollients in patients aged over 60 years with dry skin. For comparison TEWL in AD patients at non lesional sites (AD-NL) and healthy controls and TEWL before and after 28-days treatment with Aquacream in participants with psoriasis.Ad is presented.

Figure 3: SC integrity before and after 28-days treatment. See Figure 2 legend for details. SC integrity was determined by measuring TEWL after experimentally damaging the skin (tape-stripping to 20 strips). If integrity is low, tape-stripping will induce more damage and the increase in TEWL will be higher.

Figure 4: Skin surface pH and broadband spectrum (caseinolytic) protease activity are significantly lower following 28 days treatment with the humectant emollient cream compared to the non-humectant emollient cream. (Left) Skin surface pH before (mean) and after (after 28 days) treatment. *Results of a Tukey-past-test shown. Dashed lines indicate skin surface pH values from Winge et al. 2011. (Right) Caseinolytic protease activity after treatment. *Results of a t-test shown.

Figure 5: (Left) SC water hydration before and after 28-days treatment. Measurements were taken the day after cessation of treatment (12-20 hours). *Results of a Tukey-past-test shown. Dashed lines indicate hydration for AD patients at non-lesional sites.

Figure 6: SC water and carboxyl group concentration before and after 20-22 hours after treatment. FTR spectra were collected after stripping the skin 3 times (removing 0.856g/cm2) to remove surface products. The amount of water across the first 3.5µm SC was quantified from the intensity of the 3300 cm^-1 band (O-H stretching) relative to amide II (1730 cm^-1) N-H bending. *Indicate the amount of carboxyl groups (r 0.532, p <0.0001). *Indicate the results of a Tukey-past-test.

Figure 7: PCA levels in the SC were elevated following treatment with the humectant emollient (that contains no PCA), indicating increased endogenous production. Water was recently found to stimulate filaggrin expression (and by inference NMF levels).8 HPLC derived PCA levels directly correlate with the amount of carboxyl groups (r 0.532, p <0.0001). *Indicate the results of a Tukey-past-test.

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FURTHER INFORMATION

For more information, please visit our website: www.shef.ac.uk/dermatologyandimmunology.