An In vivo Comparative Study on Ageing Skin: A Bio-Mimetic versus a Traditional Approach to Skin Moisturisation

Todorova, Petya1,2, Kurimo, Ritva2, Tamburic, Slobodanka1, Grant-Ross, Peter3
1School of Management and Science, London College of fashion, University of the Arts London, United Kingdom
2Laurea University of Applied Science, Vantaa, Finland
3LF Beauty (UK) Ltd., Trowbridge, UK

Introduction
Skin dryness is a common condition in elderly individuals. The two main mechanisms to cosmetically alleviate this state rely on the effects of humectants and occlusive substances, mostly in combination. However, products nowadays aim to go beyond the simple humectant and occlusive effects and to deliver ‘moisturising actives’, such as skin-identical lipids, natural moisturising factor (NMF) components, lipid precursors, peptides and amino acids. A relatively recent approach to increasing skin moisturisation is the bio-mimetic mechanism. This approach involves application of multi-lamellar lipid structures similar to the skin surface lipids which would promote the reconstruction of the lamellar structures of the stratum corneum and the restoration of the skin barrier function. As defined by the Centre for Bio-mimetics at the University of Reading (2007), bio-mimicry is the abstraction of good design from nature and its use as inspiration for research.

Aim
To determine whether a bio-mimetic cream can deliver superior moisturisation to the skin of human volunteers aged over 60, compared to the effects of a conventional moisturiser containing high levels of petrolatum and mineral oil.

Materials and Methods
Test Products
An essential factor for the selection of skin identical lipids for a moisturisation study is their composition. Studies by Thornfeldt (2000) and Mao-Qiang et al. (1995) have shown the importance of lipid ratios and how topical applications of individual lipids or incomplete mixtures of lipids could interfere with barrier recovery instead of promoting it. Two commercially available bio-mimetic active ingredients containing approximately 2.5% active content of skin-identical lipids were selected for the formulation of test products. Both of the blends claim to have a composition similar to the skin surface lipids.

Skin Lipids

<table>
<thead>
<tr>
<th>Active I</th>
<th>Active II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triglycerides</td>
<td>Caprylic/Capric Triglycerides</td>
</tr>
<tr>
<td>Fatty Acids</td>
<td>Palmitic Acid</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>Phytosterols</td>
</tr>
<tr>
<td>Ceramides</td>
<td>Ceramide 3</td>
</tr>
<tr>
<td>Phospholipids</td>
<td>Phospholipids</td>
</tr>
<tr>
<td>Squalane</td>
<td>Squalane</td>
</tr>
</tbody>
</table>

Table 1. Comparison of the components of skin lipids and the two actives

Both actives claim to work by forming a protective barrier on the skin and restoring the missing lipids, thus providing care for dry and sensitive skin. They were formulated into an emulsion vehicle containing Glycercine, Carbomer, Caprylic/ Capric Triglyceride, preserved water, Sodium Hydroxide, Disodium EDTA and Tocopheryl Acetate, stabilised with an Alky Polyglucoside emulsifier system.

Study Design
This in vivo study was carried out in two stages.

Testing equipment:
• Conoemometer CM825 (Courage + Khazaka electronic GmbH, Germany)
• Skin-pH Meter PH905 (Courage + Khazaka electronic GmbH, Germany)

Stage I
The two prototypes were tested against a no-application site and a commercial product containing petrolatum and mineral oil as moisturising ingredients. 16 volunteers were recruited for a 4-hour blind skin hydration trial on the lower legs, using randomised intra-individual left-right comparison. The study was conducted after a one-week wash-out phase of no moisturiser application on the test sites.

Stage II
The better performing prototype from Stage I was then tested against the commercial product in a mini-regression study with 2 weeks of application (Monday to Friday) twice daily and a one-week regression phase. This included application of a bio-mimetic prototype on one lower leg (skin) and the back of hand (dorsal part), and a commercial product on the other lower leg and hand. 20 participants were recruited provided with the test products and a basic hand and body wash in order to standardise their cleansing routines. Skin hydration and pH measurements were recorded at baseline, after one and two weeks of product application, and at the end of the one-week regression stage. At the end of the trial, the participants submitted a self-assessment questionnaire, which was used to compare instrumental results with the consumers’ impressions of the two products. The data obtained from the two trials were evaluated using the “R” software package for statistical computing.

Results and Discussion
The analysis on the short-term study revealed no statistically significant difference between the effects of the two bio-mimetic prototypes. However, both prototypes significantly better than the commercial product and the no application control site. This is visually demonstrated by Figure 1.

![Figure 1. Tukey HSD test results for statistical significance between the different test products and the different time points: A: Active I; B: Active II; C: commercial product; D: Baseline; H1, H2 and H3 = 1, 2 and 3 hours after application, respectively.](image)

The long-term study showed significantly better performance of the bio-mimetic prototype on both leg and hand sites, compared to the commercial product. The skin hydration values for the bio-mimetic prototype continued to increase even in the regression phase, while the commercial benchmark values were declining. This effect was observed on both test sites (Figures 3 and 4).

![Figure 2. Changes in the SC hydration during the 4-hour study for three test products and a no-treatment control (n=16).](image)

![Figure 3. Changes in skin hydration during a 3-week regression study on the back of hands (n=20).](image)

![Figure 4. Changes in skin hydration during a 3-week regression study on the lower legs (n=20).](image)

Conclusion
This study has demonstrated that using products based on lipids identical to those that make up the natural skin barrier can improve the skin hydration to a greater extent than a conventional o/w emulsion based on excipients and humectants.

In addition, it has shown that using bio-mimetic moisturisers is an effective and long-lasting method to alleviate dry skin condition in people over 60.

References
• Centre for bio-mimetics (2007): “What is biomimetics?” University of Reading.

Acknowledgments
The authors wish to acknowledge the contribution of Anne Almland in organising the trials. This work was presented at the IFSCC Congress Paris 2014 with financial support from the Society of Cosmetic Scientists (United Kingdom).

Contact details: PetyaTodorova@lfbeauty-uk.com