Key Skin Benefits from L-Carnitine

Acts at a cellular level to deliver advanced skin health appearance benefits:

- Potential to enhance skin’s cellular energy and enable faster skin cell turnover to promote the appearance of younger-looking skin.
- Helps to up-regulate expression of key components of the skin’s extracellular matrix (ECM).
- Contributes to skin strength and elasticity.
- Promotes maintenance of effective skin barrier to maintain healthy skin hydration.
- Enables inhibition of degradative skin enzymes which can destroy skin’s collagen and lead to appearance of wrinkles and skin aging.

References

http://borum.ifas.ufl.edu/Investigators/cteam/whatcarn.html
Djouadi, F et al., Correction of Fatty Acid Oxidation on Carnitine Palmitoyl Transferase 2-Deficient Cultured Skin Fibroblasts by Bezafibrate. Pediatric Research Vol. 54, No.4: 446-451, 2003.
Foster, D., The role of the carnitine system in human metabolism.
L-Carnitine is seen to provide nutrients to enhance cell metabolism in in-vitro culture. [Table 2] Here, optimum concentration is 0.05% L-Carnitine.

L-Carnitine assists improvement in the cell growth rate. This can enable accelerated skin cell turnover and can promote the appearance of younger-looking skin.

Table 2: L-Carnitine’s Enhancing Properties on Cell Metabolism

<table>
<thead>
<tr>
<th>Control</th>
<th>L-Carnitine Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.01%</td>
</tr>
<tr>
<td>Optical Density</td>
<td>0.2</td>
</tr>
</tbody>
</table>

- Cell suspension of murine fibroblasts in assay wells.
- Add 2% fetal calf serum + test concentrations of L-Carnitine to assay wells.
- Incubate at 37°C for 72 hours.
- Absorbance of stained cells correlates with cell number.
- Cell growth rate in culture will increase when the culture media contains nutrients, in adequate concentration, needed by metabolism.

Figure 3: L-Carnitine’s Role in Skin

References

L-Carnitine up-regulates expression of key skin components in DNA microarray evaluations (Tab. 4)

- L-Carnitine up-regulates expression of genes responsible for key components of the skin’s extra-cellular matrix.
- L-Carnitine up-regulates expression of TIMP-1, a skin enzyme which inhibits the destructive collagenase, MMP-1.

Table 4: Effect of L-Carnitine Upon Expression of Key Skin Components According to DNA Microarrays(a)

<table>
<thead>
<tr>
<th>Gene</th>
<th>Function</th>
<th>DNA Full Skin Thickness Array</th>
<th>DNA Fibroblast Array</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagen</td>
<td>Most abundant collagens in skin. Adds to skin strength and elasticity. A decrease leads to wrinkles and skin aging</td>
<td>•</td>
<td>□</td>
</tr>
<tr>
<td>Types I and III</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fibronectin</td>
<td>Helps create a cross-linked network in the extra-cellular matrix (ECM) by providing binding sites for the ECM components</td>
<td>•</td>
<td>□</td>
</tr>
<tr>
<td>Types I and III</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proteoglycan</td>
<td>A major component of ECM filler between cells. Involved in binding water.</td>
<td>•</td>
<td>□</td>
</tr>
<tr>
<td>Keratin</td>
<td>Helps to prevent water evaporation from skin. Contributes to skin strength. Cell proliferation in the epidermis (Keratin Type 5).</td>
<td>•</td>
<td>□</td>
</tr>
<tr>
<td>Types 1, 2 and 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involucrin</td>
<td>A structural component of mature, squamos epithelial cells.</td>
<td>•</td>
<td>□</td>
</tr>
<tr>
<td>TIMP-1</td>
<td>Inhibits destructive skin enzymes, MMP-1 (collagenase). Able to promote cell proliferation in a wide range of cell types.</td>
<td>•</td>
<td>□</td>
</tr>
</tbody>
</table>

(a) DNA microarray testing performed by BioInnovation Laboratories, Inc. Colorado, 2007.

Interpretation by Lonza, Inc.

- DNA microarrays enable analysis of changes in gene expression due to exposure to active ingredients.
- Changes in the mRNA of thousands of genes can be monitored in a single experiment.
- Here, the effect of L-Carnitine was evaluated in both full thickness tissue equivalent (mostly keratinocytes) and fibroblast cell culture models.
Manifestation of L-Carnitine’s Benefits by Clinical Efficacy

Epidermal Turnover – The enhanced level of cellular energy from beta-oxidation helps to accelerate synthesis of the new skin cells to more quickly replace the upper, older cells and reduce the renewal time of the epidermis.

- Skin treated with L-Carnitine shows a statistically significant decrease in the mean epidermal renewal time ($P = 0.048$) to 18.10 days vs. 20.6 days with the placebo formulation. (Figure 5)

Figure 5: L-Carnitine’s Effect on Epidermal Turnover

Clinical Test Protocol

Site:
- Inner forearms of ten panelists

Exposure time:
- Product applied daily for 28 days

Test formulations:
- Untreated Skin
- Skin Cream Base without L-Carnitine
- Skin Cream Base + 2 % L-Carnitine

Protocol:
- All test sites are treated with 5 % dansyl chloride in petrolatum. Product is applied to the test sites. Fluorescence is evaluated at baseline, 7, 10, 14, 18, 21, 25 and 28 days. Renewal time is time (in days) needed for the stratum corneum to show no fluorescence.

Hydrating Power

The cells of the stratum corneum, which are generated by the metabolically active corneocytes of the inner layers, work as a trap for water molecules.

- Skin treated with L-Carnitine shows a statistically significant increase ($P = 0.002$) of 26.4 % in the skin hydration vs. 12.5 % with the placebo formulation. (Figure 6)

Figure 6: L-Carnitine’s Hydrating Power on Skin

Clinical Test Protocol

Site: Inner forearms of ten panelists

Exposure time: Product applied daily for 21 days

Test formulations:
- Untreated Skin
- Skin Cream Base without L-Carnitine
- Skin Cream Base + 2 % L-Carnitine

Protocol: Corneometer measures the skin water at baseline, and at 7, 14 and 21 days.
Key Product Attributes

Lonza’s patented L-Carnitine production process imitates the last step of the L-Carnitine’s biosynthesis that occurs in the human body and involves the same enzyme. Only pure L-Carnitine is produced, with no toxic by-products.

- Production process is based on fermentation and results in pure L-Carnitine.
- pH is 6.5 – 8.5 (2.5g / 50 ml)
- White, crystalline solid
- Hygroscopic

References
1 Lonza’s Carnipure™ brochure, 2007.
3 Data from Ager, reported December 1995:
   Product: L-Carnitine as Active Cosmetic Principle
   Object: Cosmetic Efficacy Evaluation
   Sponsor: Lonza, Basel, Switzerland