Personal Care

Carnipure™ Crystalline and Carnipure™ Tartrate

Energy for Skin & Hair

Carnipure™ Crystalline
INCI: Carnitine
SAP Code #: 198331

Carnipure™ Tartrate
INCI: Carnitine
SAP Code #: 198335

Key Product Benefits

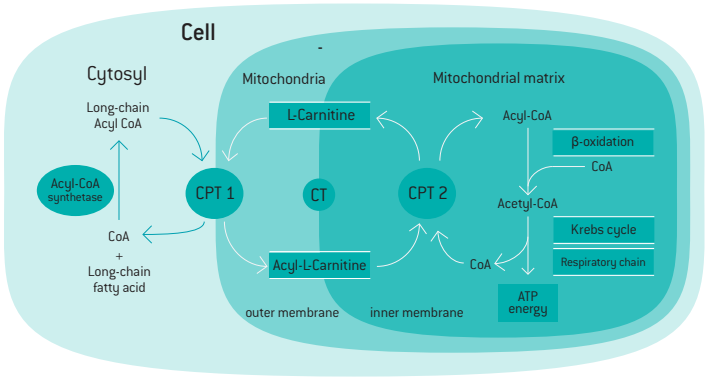
- Internal/External uses
- Increases epidermal turnover
- Maintains healthy skin hydration levels

Recommended Use Level

1–2%

Introduction

Carnipure™ Crystalline is used as a nutritional supplement in several applications including weight management, promotion of heart health and enhancement of exercise recovery. Now this same highly purified molecule is available for use in skin and hair care applications. The proprietary and fully backward integrated Carnipure™ production process was invented by Lonza scientists in Switzerland. It directly produces the L-isomer of carnitine, the form found in nature.



Background Information

Research studies *in-vitro* indicate that Carnitine's role at the cellular level may also contribute benefits to skin and hair. Carnitine plays a key role in beta-oxidation, giving it the potential to enhance skin's cellular energy via increased cellular metabolism, resulting in accelerated epidermal barrier synthesis. It promotes the inhibition of degradative skin enzymes such as MMP1 (Matrix-Metalloproteinase) and MMP2. Carnitine has also been shown to up-regulate the expression of beneficial genes responsible for the production of key skin components such as collagen, fibronectin and involucrin. (Fig. 1)

Efficacy Studies

***In vitro* Effect of Carnitine on Cellular Metabolism**

Carnitine enhances cellular metabolism of fibroblasts in culture at a concentration of 0.05% (Table 1). Carnitine causes an upsurge in cellular growth rates, accelerating skin cell turnover and promoting the appearance of younger looking skin.

How the energy may be used

Micro-Nutrient		*In vitro*		Efficacy
ATP Generation for Intracellular Energy Transfer	[1,2]A reconstructed skin equivalent was cultured with Carnitine for two days and 14C-acetic acid for eight hours – Significant increase in β-oxidation in keratinocytes was seen in Carnitine cultures after three days – Amount of 14CO2 released from 1-14C palmitate oxidation	Carnitine increased the synthesis of lipids in the *in vitro* skin equivalent– ceramides, fatty acids, cholesterol (thin layer chromatography)	Carnitine may have helped to accelerate epidermal barrier synthesis	Topical application of an Carnitine skin cream (six weeks) gave: – Significantly higher moisture content in stratum corneum – Reduced TEWL – Improved appearance of fine lines and wrinkles on face after 12 weeks (expert grader) – Improved overall skin texture (Primos 3D (GFM, Germany))

MMPs breakdown the extra-cellular matrix of skin and can be activated by UVA radiation

Matrix-Metalloproteinase (MMP) Inhibition		*In vitro*		Efficacy
Inhibition of Degradative Skin Enzymes	[3] UVa-exposed human dermal fibroblasts were cultured with Carnitine for 24 hours	Compared to irradiated cells Carnitine decreased production of: – MMP1 (collagenase) 43 % – MMP2 (gelatinase) 53 %	Carnitine may have helped to inhibit protein synthesis of these enzymes	Topical application of a 1% Carnitine skin cream (three months) gave: – Significantly reduced the appearance of roughness parameters associated with facial wrinkles skin replica analysis by Skin Visiometer® SV600 (CK, Germany)

Carnitine's enhancing properties on cell metabolism

	Control	Carnitine Concentration			
	–	0.01%	0.05%	0.10%	0.50%
Optical Density	0.2	0.41	0.48	0.40	0.34

Table 1

Test Protocol

- Cell suspension of murine fibroblasts in assay wells
- Add 2 % fetal calf serum + test concentrations of Carnitine to assay wells
- Incubate at 37° C for 72 hours
- Absorbance of stained cells correlates with cell number (higher optical density = higher cell concentration)

DNA Microarray Evaluation

In-vitro, Carnitine up-regulates the expression of many genes responsible for the production of key components of the skin's extra-cellular matrix.

Effect of Carnitine upon expression of key skin components according to DNA MicroArrays*

Gene	Function	DNA full skin thickness array	DNA fibroblast array
Collagen Types I and III	Most abundant collagens in skin. Adds to skin strength and elasticity. A decrease leads to wrinkles and skin aging	■	■
Fibronectin Types I and III	Helps create a cross-linked network in the extra-cellular matrix (ECM) by providing binding sites for the ECM components	■	■
Proteoglycan	A major component of ECM filler between cells. Involved in binding water	■	–
Keratin Types 1, 2 and 5	Helps to prevent water evaporation from skin. Contributes to skin strength. Cell proliferation in the epidermis (Keratin Type 5)	■	■
Involucrin	A structural component of mature, squamos epithelial cells	■	■
TIMP-1	Inhibits destructive skin enzymes, MMP-1 (collagenase). Able to promote cell proliferation in a wide range of cell types.	■	■

Table 2

* DNA microarray testing performed by BioInnovation Laboratories, Inc. Colorado, 2007. Interpretation by Lonza, Inc. DNA microarrays[2] 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 Carnitine was evaluated in both full thickness tissue equivalent (mostly keratinocytes) and fibroblast cell culture models.

In vivo Epidermal Turnover Study

The enhanced level of cellular energy from beta-oxidation helps in epidermal turnover and a reduced renewal time of the epidermis. Skin treated with Carnitine shows a statistically significant decrease in the mean epidermal renewal time (P= 0.048) from 20.6 days for the placebo formulation to 18.1 days for the test formulation (Fig 2).

Carnitine's effect on epidermal turnover

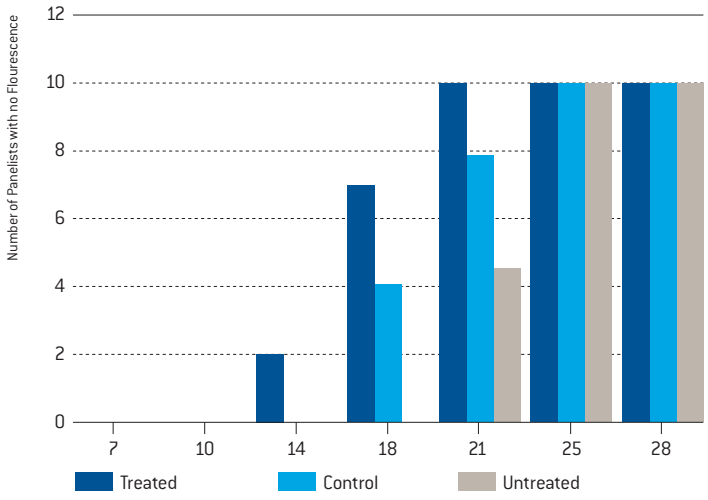


Fig. 2

Efficacy Protocol

Site: Inner forearms of ten panelists

- Exposure time: Product applied daily for 28 days
- Test formulations:
  - Untreated skin
  - Emulsion base without Carnitine (control)
  - Emulsion base + 2% Carnitine
- Procedure: All test sites were treated with 5% dansyl chloride in petrolatum. Product was applied to the test sites. Fluorescence was evaluated at baseline, 7, 10, 14, 18, 21, 25 and 28 days. Renewal time is number of days needed for the stratum corneum to show no fluorescence

Corneometer Study

Corneocytes in the outer layer of the skin, which are generated by the metabolically active cells of the inner layer, work as a trap for water molecules, thus providing the skin with moisture. Skin treated with Carnitine shows a statistically significant increase (p=0.002) of 26.4% in skin hydration versus 12.5% with the placebo formulation. (Fig. 3)

Carnitine's hydrating power on skin

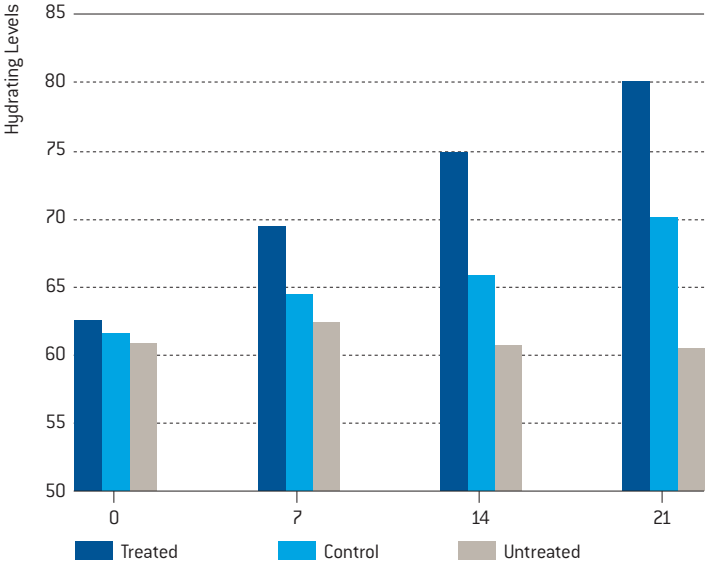


Fig. 3

Test Protocol:

- Site: Inner forearms of ten panelists
- Exposure time: Product applied daily for 21 days
- Test formulations:
  - Untreated skin
  - Emulsion base without Carnitine
  - Emulsion base + 2% Carnitine
- Procedure: Corneometer measurements of skin water content at baseline, 7, 14 and 21 days

References

1. http://borum.ifas.ufl.edu/Investigators/cteam/whatcarn.html
2. Lamhonwah, AM., Tein, I, Novel localization of OCTN1, an organic cation/carnitine transporter, to mammalian mitochondria. Biochemical and Biophysical Research Communication 345: 1315-1325, 2006.

USA
Lonza Consumer Care
70 Tyler Place
South Plainfield, NJ 07080
Tel +1 908 561 5200

Switzerland
Lonza Ltd
Muenchensteinerstrasse 38
4002 Basel
Tel +41 61 316 81 11

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