

# SKIN MOISTURIZING FACTORS: METHOD OF DETERMINATION

P. Morganti <sup>1)</sup>, S.D. Randazzo <sup>2)</sup>

<sup>1)</sup> President/Director Research & Development, Mavi Sud s.r.l. - Aprilia (LT) (Italy)

<sup>2)</sup> Professor of Experimental Dermatology University of Catania - Catania (Italy)

**RECEIVED:** October 27, 1989. Presented at the 3rd INTERNATIONAL CONGRESS ON COSMETIC DERMATOLOGY. "PROGRESS IN COSMETIC DERMATOLOGY". October 27-29, 1989 Vienna (AUSTRIA).

**KEY WORDS:** Cutaneous Hydration; Skin Surface Lipids; Skin Soothing Index; Skin Hydration Index; Dermotest Hytech; Sebumeter SM 810 PC; Corneometer CM 820 PC; Emollient Cream; Moisturizing Cream.

---

## Synopsis

The usual protective function of the skin is directly related to the protective action of the surface lipid film and to its water contents.

The surface lipid film covers the skin as barrier against the aggressions of external environment. The water is indispensable in keeping the skin smooth, elastic, and hydrated.

Cosmetic products are required either to keep the cutaneous hydrolipidic film unchanged, or to restore it through the proper contribution of sebum-like lipids and water, which is the only plasticizer of the corneal layer.

In order the best use the vast knowledge now being acquired in Cosmetic Dermatology, standardization techniques have been investigated for different problem areas. Our current objective in such standardization, applied to the hydrolipidic film, is to link the use of a proper cosmetic product to previously determined corrective factors. These factors are named "hydration index" and "soothing index" respectively, depending their capability to give to skin the right amount of water or of lipids sufficient to retain or re-establish a proper balance.

In order to establish each index we employed a computer-supported system named Dermotest Hytech to measure surface sebum and skin hydration. This system is made up of Sebumeter SM 810 PC and Corneometer CM 820 PC connected to a personal computer using proprietary software.

This system makes sebum data directly available in  $\mu\text{g}/\text{cm}^2$  and cutaneous hydration in CV (Corneometer Values). From this, we have developed each index.

The Hydration Index (HI) is the ratio between the hydration present in a treated skin surface area, monitored for temperature and humidity ( $t=22^\circ\text{C}$ ,  $\text{RH} \geq 50\%$ ), and the same when not treated. For convenience the result is multiplied by 10.

The Soothing Index (SI) is the result of dividing the read-out value of a treated skin surface area by the value from the same area when non treated. This result is multiplied by 4.

## Riassunto

La normale funzione protettiva della cute è strettamente legata all'azione protettiva svolta dal film lipidico di superficie che la ricopre come una barriera, difendendola dalle aggressioni dell'ambiente esterno, e dal suo contenuto di acqua, indispensabile per mantenerla morbida elastica ed idratata.

Compito dei prodotti cosmetici è di mantenere inalterato o di reintegrare il film lipidico cutaneo mediante l'apporto calibrato dei lipidi sebo-affini e dell'acqua, considerata unico plastificante dello strato corneo.

Per utilizzare nel migliore dei modi le vaste conoscenze acquisite nel settore della Dermatologia Cosmetologica, si è cercato di standardizzare il riconoscimento dei diversi tipi cutanei, legandolo direttamente ad un adatto cosmetico, mediante l'utilizzazione di precisi fattori di correzione. Tali fattori vengono denominati rispettivamente "indice di idratazione", se in grado di apportare alla cute la giusta quantità di acqua, o "indice di emollienza", se in grado di apportare lipidi in quantità sufficiente al suo riequilibrio.

Per la misurazione sia del sebo di superficie che dell'idratazione cutanea ci si è serviti di un sistema computerizzato denominato Dermotest Hytech dato dall'unione del Sebumeter SM 810 PC e del Corneometer CM 820 PC, opportunamente collegati ad un PC mediante un adeguato programma di utilizzazione. Utilizzando il Dermotest Hytech è stato possibile ottenere direttamente sia i valori sebometrici espressi in  $\mu\text{g}/\text{cm}^2$  che i valori della idratazione cutanea espressi in CV (corneometer values).

Si definisce, pertanto, indice di idratazione il rapporto tra lo strato di idratazione di una cute trattata a temperatura e umidità controllata ( $t = 22^\circ \text{C}$  RH  $\geq 50\%$ ), rispetto alla stessa cute non trattata moltiplicando il risultato per un coefficiente dieci. L'indice di emolliente si ricava dividendo il valore del casual level cutaneo di una cute trattata per l'analogo valore della stessa cute non trattata, moltiplicando il risultato per un coefficiente quattro.

## Introduction

One of the major efforts in cosmetic dermatology is to keep a youthful appearance to the skin. This is chiefly accomplished by helping to retain a necessary amount of moisture in the stratum corneum. For this reason the so-called "emollient" and "moisturizing" cosmetic products are not formulated simply to act as lubricants, but also to preserve or to restore cutaneous homeostasis.

Well formulated cosmetics delay water evaporation (*perspiratio insensibilis*) and, thereby, help to retain water in the stratum corneum and to restore the surface lipid film. This lipid film is, in fact, the indispensable regulator of water

exchanges between the dermis and the surface skin layers. (1-14).

In order to develop methods for testing the activity of moisturizing and sebum-normalizing cosmetics, specific "hydration" and "soothing" indices are suggested. These indices are intended to be directly correlated to the individual biotypological conditions of each skin tested. (15,16)

The "hydration index" is the ratio between the water retention in the surface layer of a treated skin area and of the same skin area prior to treatment. The result is multiplied by a factor 10. Testing is done under standardized conditions of temperature ( $t=22^\circ \text{C}$ ) and relative humidity (RH $\geq 50\%$ ).

The "soothing index" is the ratio between the

sebum content of the surface layer of a treated skin area and of the same skin area prior to treatment. The result is multiplied by a factor 4 (15).

These two indices make it possible to balance the use of moisturizing and emollient creams according to the index values obtained (16).

## Materials and Methods

### Materials

#### CLEANSING LOTION

Water, cetereth (and) isopropyl myristate, isoctyl stearate, sorbitol, glycerin, propylene glycol, tocopheryl acetate, retinyl palmitate, imidazolidinyl urea, fragrance, ethyl linoleate (and) ethyl linolenate, methyl paraben, desamidocollagen, EDTA.

#### HI-5 Gel

Water, methylgluceth-10, soluble collagen, PEG-40 hydrogenated castor oil, PEG-13 octanoate, carbomer 934, sodium glycine, hydrolyzed animal protein, tocopheryl acetate UVA-filter, fragrance, quaternium-15.

#### HI-10 Cream

Water, PEG-8-C 12-18, isopropylheptanoate, sorbitol, ceresin, sorbitan sesquioleate, hydrogenated castor oil, borage oil, desamidocollagen, glycerin, fragrance, sodium PCA, witch hazel extract, imidazolidinyl urea, UVA-filter, cyclomethicone, ethyl linoleate methyl paraben, lecithin, trisodium EDTA.

#### HI-20 Cream

Essential fatty acids, phospholipids, benzophenone, A, E vitamins, borage oil, in a sebumlike carrier.

#### SI-5 Gel

Water, methyl gluceth-10, soluble collagen, PEG-40-Hydrogenated castor oil, cetearyl octanoate, sodium glycine, UVA filter, fragrance, tocopheryl acetate, carbomer 934.

#### SI-10 Cream

Water, sodium PCA, cetyl dimethicone copolyol, cetyl dimethicone, polyglyceryl oleate, hexyl laurate, cyclomethicone, glycerin, isopropylalanoate, retinyl palmitate, squalene, sodium chloride, cetearyl octanoate, tocopheryl acetate, linoleic and linolenic acid, quaternium-15.

#### SI-20 Cream

Water, jojoba oil, ciclomethicone, octyl stearate, caprylic capric acid triglyceride, dimethicone copoliol squalano, PCA sodium, glycerin, soluble collagen, UVA-filter, tocopheryl acetate, retinyl palmitate, fragrance, methyl and propyl paraben.

Surface sebum and skin hydration are measured by the use of a computer-supported system called Dermotest Hytech. This system is made up of the Sebumeter SM 810 PC and the Corneometer CM 820 PC which are connected to a PC through proprietary software. The Dermotest Hytech reports sebum data in  $\mu\text{g}/\text{cm}^2$  and reports the skin hydration in Corneometer Values (CV) by direct readout.

### Methods

60 women aged 22 to 33 were divided into six group of ten people:

#### Group 1:

"Hyperlipidic" group with a sebum level of  $720 \pm 42 \mu\text{g}/\text{cm}^2$ .

#### Group 2:

"Normolipidic" group with a sebum level of  $300 \pm 53 \mu\text{g}/\text{cm}^2$ .

#### Group 3:

"Alipidic" group with a sebum level of  $175 \pm 26 \mu\text{g}/\text{cm}^2$ .

#### Group 4:

"Normohydrated" group with a mean hydration level of  $117 \pm 16 \text{ CV}$ .

#### Group 5:

"Dehydrated" group with a mean hydration level of  $72 \pm 13 \text{ CV}$ .

Group 6:  
 "Very dehydrated" group with a mean hydration level of  $30 \pm 11$  CV.

Four weeks before, and during all the treatment period, drugs and diet foods were prohibited. In the ten days before treatment, all subjects used no cosmetics except a cleansing lotion provided by us, and a different creams to be applied twice a day (AM and HS) after using the cleansing lotion and abundant rinsing.

The mean values for surface sebum and skin hydration were taken from each subject by carrying out four separate measurement in adjacent areas on the forehead. Measurements were taken between 8:30 and 10:30 a.m. under standardized conditions. This procedure is based upon the method of Saint Leger and Levecque as modified by Borroni et al, (17,18).

With these values as bases, the subjects were divided into the 6 groups, each group being given the corrent cosmetics for their skin category. In particular, the first, the second and the third group were given similary formulated cosmetics enriched with increasing amounts of lipids. The fourth, the fifth and the sixth group were given substances well known to be active in skin hydration (native collagen PCNa\* and organic silicone derivatives).

Before starting our tests, studies that allowed us to balance our formulations were carried out both "in vitro" and "in vivo".

These reduced empirical evaluation as much as possible.

Soon after the use of selected cosmetic cream, delicately applied in the quantity of a fine film, sebum and skin hydration were measured again. Result are listed in Figures 1 and 2.

The reference invoices for the "soothing index" (lipidic state) have been obtained from the mean values of each group by means of the following formula:

$$\text{"SOOTHING INDEX"} = \frac{\text{VALUE AFTER}}{\text{VALUE BEFORE}} \times 10$$

The formula for the "moisturizing index" is the following:

$$\text{"MOISTURIZING INDEX"} = \frac{\text{VALUE AFTER}}{\text{VALUE BEFORE}} \times 4$$

Therefore for each group of individuals the mean obtained values are:

*Group 1:*

$$\frac{376}{743} \times 10 = 5 \text{ soothing index}$$

*Group 2:*

$$\frac{310}{310} \times 10 = 10 \text{ soothing index}$$

*Group 3:*

$$\frac{363}{182} \times 10 = 20 \text{ soothing index}$$

*Group 4:*

$$\frac{116}{92} \times 4 = 5 \text{ hydrating index}$$

*Group 5:*

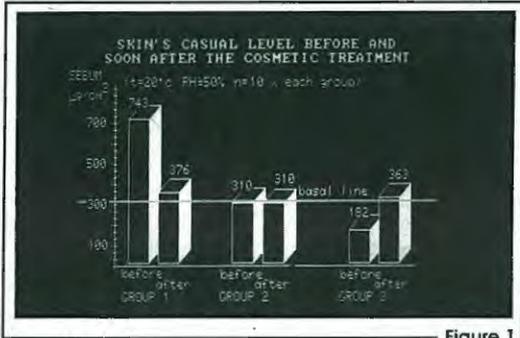
$$\frac{114}{46} \times 4 = 10 \text{ hydrating index}$$

*Group 6:*

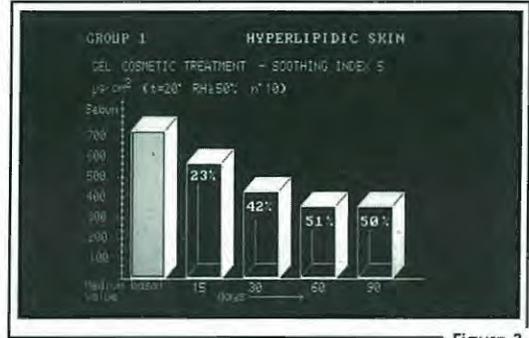
$$\frac{118}{26} \times 4 = 20 \text{ hydrating index}$$

This system has enable us to correlate various skip types with correction methods appropriate to them. This new experimental method, called Dermotest, utilizes colored diodes to provide simple and fast sebum and skin hydration measurements. After 15, 30, 60 and 90 days, readings were taken in order to verify a correlation

\* Pyrrolidone carboxylic acid sodium salt



Sebum values before and soon after the cosmetic treatment



Group 1 - Hyperlipidic Skin

Cosmetic Gel Treatment - Soothing Index 5

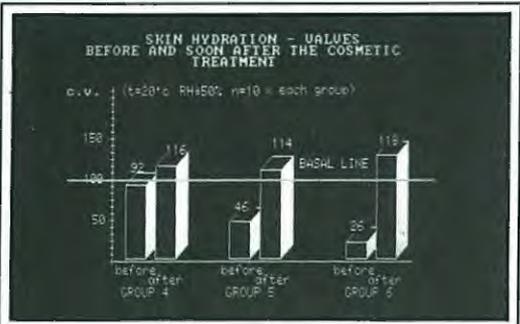


Figure 2

Skin hydration (corneometer values) measured before and soon after the cosmetic treatment

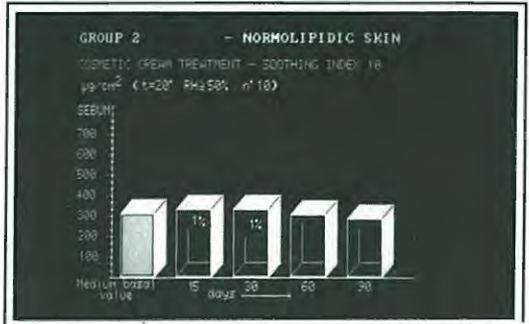


Figure 4

Group 2 - Normolipidic Skin  
Cosmetic Cream Treatment - Soothing Index 10

between the correction indices originally obtained by Dermotest, and the results obtained after the use of the cosmetic selected for that individual. Results are shown in Figure 3-8.

## Results and Comments

As shown in Figure 3-8, the cosmetics which were selected for use normalized all the skin types tested. Positive effects were observed during the first 30 days. After 60 days, both the dehydrated skin and the skin with depleted or excess lipid content returned to normal mean values. It is interesting that a gradual decrease in average levels was noted in the first group (Hyperlipidic), with high sebum values. (Fig. 3) A normalization of the surface lipid film was observed in the third group (alipidic) after only 30 days of treatment. (Fig. 5)

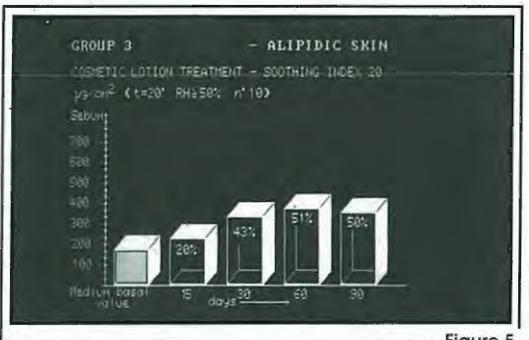


Figure 5

Group 3 - Alipidic Skin  
Cosmetic Lotion Treatment - Soothing Index 20

In the final 2 groups, made up of individuals with dehydrated to very dehydrated skin, simi-

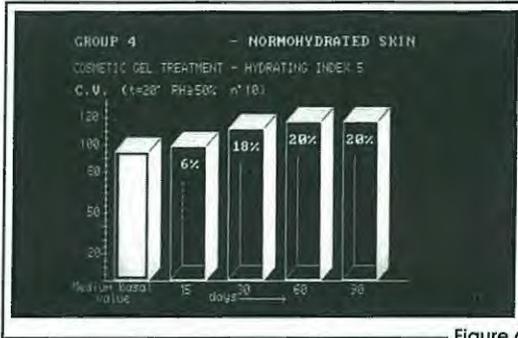


Figure 6

Group 4 - Normohydrated Skin  
Cosmetic Gel Treatment - Hydrating Index 5

Supported by these first results proving the effectiveness of our correction indexes, we keep on doing our experiments in order to evaluate more thoroughly the activity of different lipidic and moisturizing materials.

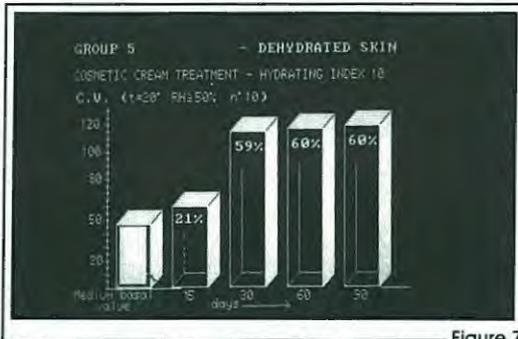


Figure 7

Group 5 - Dehydrated Skin  
Cosmetic Cream Treatment - Hydrating Index 10

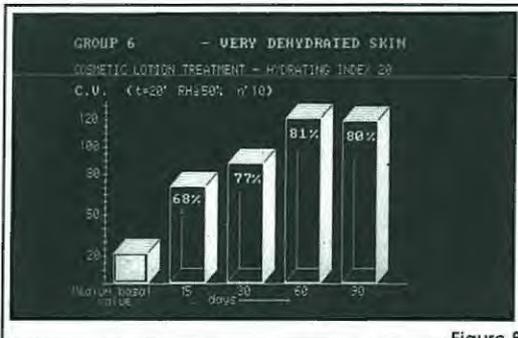


Figure 8

Group 6 - Very Dehydrated Skin  
Cosmetic Lotion Treatment - Hydrating Index 20

lar results were obtained soon after 30 days of treatment. In these the skin returned to normal mean values, keeping the hydration up to the end of tests (Fig. 7,8).

## Acknowledgments

The authors gratefully acknowledge the financial support of this study by MAVI SUD s.r.l. - Viale dell'Industria, 1 - Aprilia (LT)

## References

1. Anderson R.L., Cassidy J.M., Hansen J.R., Yellin W. (1973): "Hydration of stratum corneum" *Biopolymers* **12**, 2789-2802.
2. Barret J.G., Scott I.R. (1983): "Pyrrolidone carboxylic acid synthesis in guinea pig epidermis" *J. Invest Dermatol.* **81**,122-124..
3. Blank I.H. (1952): "Factors which influence the water content of the stratum corneum" *J. Invest. Dermatol.* **18**,443-440.
4. Blank I.H. (1953): Further observation on factors which influence the water content of the stratum corneum" *J. Invest Dermatol.* **21**,259-69.
5. Blank I.H., Shappirio E.B. (1955): "The water content of the stratum corneum, effect of previous contact with aqueous solution of soap and detergent" *J. Invest Dermatol.* **25**,391-401.
6. Chernosky M.E. (1976): "Clinical aspects of dry skin" *J. Soc. Cosmet. Chem.*, **27**,365.
7. Chernosky M.E. (1972): "Dry skin and its consequences" *J. Amer. Med. Women's Ass.* **4**,133-45.
8. Chernosky M.E. (1962): "Pruritic skin disease and summer air conditioning" *Amer. Med. As.*, **179**,1005-10.
9. Flesh P. (1963): "Chemical basis of emollient function in horny layers" *Proc. Sci. Sec.TGA*, **n.40**: 12-16.
10. Jmokawa G., Hettori A. (1985): "A possible function of structural lipid in the water-holding of the stratum corneum" *J. Invest. Dermatol.* **84**, 282-284.
11. Jacobi O. (1959): "About the mechanism of moisture regulation in the horny layer of the skin" *D.C.I.* **84**,732.
12. Laden K., Spitzer R. (1967): "Identification of a natural moisturizing agent in the skin" *J. Soc. Cosmet. Chem.* **18**,351.
13. Middleton J. D. (1968): "The mechanism of water binding in stratum corneum" *Brit. J. Dermatol.* **80**,437-50.
14. Morganti P. (1987): "I derivati biologici nell'idratazione cutanea" in (A. Giardina Ed.): *Idratazione e dermocomesi*, **41**.
15. Morganti P., Randazzo S.D. (1989): "L'utilizzazione degli indici di correzione per il trattamento cosmetico della cute secca e disidratata." *Il prodotto chimico* **31**(3): 17.
16. Morganti P., Randazzo S.D. (1989): "Gli indici di idratazione e di emollienza per la verifica dello strato cutaneo" *Incontri di cosmetologia*, **3**:113 (suppl. al n. 26 di Cosmesi Dermatologica).
17. Saint-Leger D., Leveque J.L. (1980): "Les methodes d'evaluation quantitative des lipides de surface chez l'homme. Presentation d'une nouvelle procedure" *Int. J. Cosmet. Sci.* **2**,283.
18. Borroni G., Gabba P., Berardesca E., Vignoli G.P., Vignati G., Gatti M., Rabbiosi G. (1988): "Detersione cutanea a livelli sebometrici" *Cosmesi Dermatologica* **21**,19.