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## **Literature List**

### **Skin-Colorimeter**

*A. del Pozo, M. Solans, C. Fernandez, M. Dolz, F. Corrias, M. Herráez, O. Diez-Sales, Efficacy evaluation and characterization of chitosan nanoemulsions with Spirulina hydro-glycolic extract, IFSCC Barcelona 2008 (Poster)*

Nanoemulsions represent an interesting prospect for use as vehicles in the development of formulations to deliver active ingredients to the human body. Particularly, nanoemulsion formulations have been shown to be superior for transdermal and dermal delivery of hydrophilic and lipophilic compounds, compared to conventional vehicles, such as hydrogels and emulsions [1]. Lecithins (phosphatidylcholines) have been used in several studies as surfactants for topical nanoemulsion vehicles. These surfactants are able to form nanoemulsions without co-surfactants.

*P. Humbert, A. Elkhyat, A. Gichard, J.M. Sainthillier, Comparison between Colorimeter CL400 Courage-Khazaka and Chromameter CR400 Minolta, CERT/Department of Dermatology, Besancon*

The aim of this study was to compare 3 colorimetric devices: 2 probes of colorimeter (CK) and Chromameter (Minolta). Therefore we assessed: ...

*K. Fritz, Skin physiologic changes before and after laser treatment, IMCAS, Congress of Plastic Surgery and Dermatology, Lecture number: 5462*

The aim of the study was to compare the changes of the biophysical properties and to objectify the effects of treatments with various lasers on skin physiology. Few studies have been reported to compare the effects of various lasers on the skin physiology which could result in a customized skin care post treatment recommendation. The recent development of various biophysical devices has made it possible to have more accurate and objective assessment methods. The functional properties of the skin are measured by utilizing non invasive techniques, including the assessments for, skin color, trans-epidermal water loss (TEWL) and skin hydration and pH (Courage and Khazaka).

*C. Uhl, D. Khazaka, Techniques for globally approved skin testing, Personal Care April 2013*

In efficacy testing and claim support for cosmetic products, objective measurement systems became indispensable long ago, especially since subjective clinical assessments are often prone to bias and inter-observer variation. Without suitable instrumentation it is close to impossible to determine what a product is really doing for the skin. Those objective measurement methods and subjective evaluations are mutually dependent. No measurement can be performed without the subjective evaluation of the results by the user of such instrumentation. However, a pure subjective evaluation of the skin without appropriate measurement techniques is not able to achieve accurate results either. This relationship becomes clearer when looking for example at skin colour measurements. Subjectively, the human brain cannot process slight changes in colour, especially when the colours are not viewed side by side, but at different points in time. Instrumental measurement however will clearly detect such slight changes. The achieved result must then be interpreted in context with the expected outcome or the hypothesis. For this, you will always need a knowledgeable and experienced person because 'a fool with a tool is still a fool', as the late Albert Kligman used to say. This

relationship between objective measurement and subjective evaluation is not only true for the determination of differences in skin colour, but also for all other skin measurement parameters important for the cosmetic industry.

*A. Mondelli, G.F. Secchi, **Proteins in pre-colouring hair care products: improving hair dyes performance on damaged hair***, Poster In-cosmetics, Paris 2013

The ability of different hydrolysed proteins applied on bleached and with different diameter (Russian and Indian) hair before colouring to improve colour deposition and retention over time after washing cycles was studied. The test showed that application on hair of the hydrolysed proteins before hair colouring can improve colour deposition and retention respect to the control tresses; colour deposition and retention are pre-treatment water solution protein content dependent.

*O. Freis, G. Perie, A. Rathjens, **Correlating Aging with Skin's Mechanical and Optical Properties***, Cosmetics and Toiletries, April 21, 2014

The evolution of skin's biomechanical and optical properties as a function of aging and/or photoaging is one of the main targets of cosmetic and dermatological research. Many noninvasive devices to measure skin's biomechanical properties have been developed using alternative methods such as stretching, torsion, indentation and suction. Measurements of skin deformation after suction or torsion are the most widely used techniques in cosmetic research. The skin's optical properties play an important role as well, and devices measuring these characteristics assess reflected light after illumination of the skin surface. Different noninvasive methods have been proposed for evaluating skin complexion in vivo. These include quantitative measurements of skin color, using colorimetry—i.e.,  $L^*a^*b^*$  and Individual Typological Angle (ITA°); or of the intensity of specular reflection and the back-scattering of light from the skin. The purpose of this study was to demonstrate the evolution of the measured parameters with aging, and to find the correlation between measured mechanical and optical properties of the skin.

*M. Wilkes, C.Y. Wright, J.L. du Plessis, A.I. Reeder, **Fitzpatrick skin type, Individual Typology Angle and melanin index in an African population: taking steps toward universally applicable skin photosensitivity assessments***, JAMA Dermatol., 2015 Aug;151(8):p. 902-3

Calculation of Individual Typology Angle (ITA) based on spectrophotometric measurements has been used to classify skin types into physiologically relevant groups,<sup>1</sup> ranging from very light to dark skin.<sup>2</sup> This study directly compares ITA values with melanin index (MI), the latter frequently used in assigning Fitzpatrick Skin Type (FST),<sup>3</sup> in order to improve understanding of how these measurements correlate when used in a study that consists, primarily, of FST V and VI. Methods: Participants ( $n=556$ ) were drawn from the Council for Scientific and Industrial Research campus in Pretoria, South Africa, from October 6-22, 2014. All participants provided written consent, spoke English, cleaned their non-dominant arm with a wet wipe, and answered a short questionnaire, self-identifying their population group and skin reaction to sunlight. Courage+Khazaka Skin Colorimeter CL 400 and Mexameter® MX 18 objectively determined ITA and MI respectively, by being held against the upper, inner non-dominant arm. ITA was categorized as previously described.

*G. Nicoletti, F. Brenta, M. Bleve, T. Pellegatta, A. Malovini, A. Faga, P. Perugini, **Long-term in vivo assessment of bioengineered skin substitutes: a clinical study***, J Tissue Eng Regen Med, 2015 Apr;9(4): p. 460-468

The aim of the study was an objective in vivo assessment of skin properties after reconstruction with two artificial dermal substitutes, Integra® and Hyalomatrix®. Twenty-seven patients underwent reconstruction of 36 skin-loss sites with full-thickness skin graft, split-thickness skin graft, Hyalomatrix® bioengineered skin substitute and sequential split-thickness skin graft and Integra® bioengineered skin substitute and sequential split-thickness skin graft. Objective assessments were carried out using three instrumental devices: Multi Probe Adapter System MPA; 22 MHz ultrasound skin scan; and Primos Pico for a three-dimensional (3D) skin scan. The skin parameters under study in our sample were: corneometry, transepidermal water loss, elastometry, colorimetry, skin thickness and 3D skin surface pattern. A skin reconstruction with Hyalomatrix seemed to most closely approach the hydration, transepidermal water loss and skin surface 3D pattern of normal skin. A skin

reconstruction with Integra seemed to demonstrate the best skin colour feature and elastic properties. Although no statistically significant differences were observed, the descriptive analysis of the outcomes might suggest a better cell regulation, regenerated extracellular matrix and neoangiogenesis with the use of Hyalomatrix, and the formation of a more elastic regenerated dermis, with overall better physical, mechanical and optical properties, with the use of Integra.

*C.Y. Wright, M. Wilkes, J.L. du Plessis, A.I. Reeder, P.N. Albers, In multiple situational light settings, visual observation for skin colour assessment is comparable with colorimeter measurement*, Skin Research and Technology 2016; 22: 305-310

Background: Finding inexpensive and reliable techniques for assessing skin colour is important, given that it is related to several adverse human health outcomes. Visual observation is considered a subjective approach assessment and, even when made by trained assessor, concern has been raised about the need for controlled lighting in the study venue. The aim of this study is to determine whether visual skin colour assessments correlate with objective skin colour measurements in study venues with different lighting types and configurations

*K.C. Lee, J. Dretzke, L. Grover, A. Logan, N. Moiemmen, A systematic review of objective burn scar measurements*, Lee et al. Burns & Trauma (2016) 4:14

Abstract: Background: Problematic scarring remains a challenging aspect to address in the treatment of burns and can significantly affect the quality of life of the burn survivor. At present, there are few treatments available in the clinic to control adverse scarring, but experimental pharmacological anti-scarring strategies are now beginning to emerge. Their comparative success must be based on objective measurements of scarring, yet currently the clinical assessment of scars is not carried out systematically and is mostly based on subjective review of patients. However, several techniques and devices are being introduced that allow objective analysis of the burn scar. The aim of this article is to evaluate various objective measurement tools currently available and recommend a useful panel that is suitable for use in clinical trials of anti-scarring therapies.

*A.C. da Silva Marques, Biometrologic Evaluation of Cosmetic Products*, Dissertation in pharmaceutical sciences at the University of Coimbra, 2016

Given the growing importance that cosmetic products have on human's health and in our daily life, it is important to increase the control of these products, both in terms of safety and effectiveness. Taking into account that conducting animal tests for the production and validation of cosmetic products is prohibited by law, producers of these products have to resort to alternative methods. Biophysical methods have gained an important highlight in the scientific community, in particular the non-invasive methods. They allow a safe and faster evaluation of cosmetics. The purpose of this work is to describe some methods and equipments used at national and European level to test the effectiveness of cosmetic products and correlate the parameters evaluated with the alleged properties in the products. The methods include evaluation tests of the following skin properties: hydration, elasticity, coloring, sebum production and perspiration.

*M. Anthonissen, J.I. Meirte, U. Van Daele, K. Maertens, P. Moortgat, Report: Minolta Chromameter CR-400 & Skin Colorimeter CL 400*, Oscare Scar-Lab, Belgium, 2017

The most commonly used method for color assessment is tristimulus reflectance colorimetry. It represents color in the same way as the human eye does. The level of light is reflected through three broad wavelength filters and the color is described by three values: L\*, the lightness or brightness; a\*, the amount of green or red (redness) and b\*, the amount of yellow or blue (pigmentation). Both the Minolta Chromameter® and the Colorimeter® are tristimulus devices and measure L\*, a\* and b\* values.

*J. Kitsongsermthon, K. Duangweang, J. Kreepoke, A. Tansirikongkol, In vivo cleansing efficacy of biodegradable exfoliating beads assessed by skin bioengineering techniques*, Skin Research and Technology 2017; 23: p. 525-530

Background/purpose: The plastic microbeads, used in many cleansers, will be banned in cosmetic and personal care products within 2017 since they are non-degradable and can disturb

the living organisms in water reservoirs. Various choices of biodegradable beads are commercially available, but their efficacy has not been proven yet. This study aimed to compare the cleansing efficacy in dirt and sebum removal aspects of three types of exfoliating beads. Methods: The gel scrubs with polyethylene (PE) beads, mannan beads or wax beads, were formulated and evaluated for their stability. The in vivo evaluation was done in 38 healthy volunteers and the skin irritation, efficacy for dirt and sebum removal were measured by Mexameter<sup>^</sup>, Colorimeter<sup>®</sup>, and Sebumeter<sup>®</sup>, respectively. Results: The selected gel scrubs did not cause an irritation in any volunteers. The differences in dirt residues between before and after scrubbing were not statistically significant among three gel scrubs and the similar result was also reported in the sebum removal study. Conclusion: All gel scrubs demonstrated the comparable cleansing efficacy in term of dirt and sebum removal. Thus, mannan beads and wax beads may be replaced nonbiodegradable PE beads to achieve the similar cleansing effect.

*G. Nicoletti, P. Perugini, S. Bellino, P. Capra, A. Malovini, O. Jaber, M. Tresoldi, A. Faga, Scar Remodeling with the Association of Monopolar Capacitive Radiofrequency, Electric Stimulation, and Negative Pressure, Photomedicine and Laser Surgery, Volume 35, Number 5, 2017*

Objective: A study was established to objectively assess the effects of low-intensity electromagnetic and electric stimulation plus negative pressure on mature scars. Background: Radiofrequency plus negative pressure therapy demonstrated a favorable reorganization and regeneration of the collagen and elastic fibers and was proposed for the treatment of cellulitis and skin stretch marks. Methods: Twenty-six mature scars in 20 Caucasian patients (15 females and 5 males) were enrolled in the study. The treatments were carried out with a Class I, BF-type electromedical device equipped with a radiofrequency generator, an electric pulse generator, and a vacuum pump twice a week for 3 months. Corneometry, transepidermal water loss, elastometry, colorimetry, and three-dimensional skin surface pattern were objectively assessed with Multi Probe Adapter System MPA and PRIMOS pico. A subjective assessment was carried out with the VAS and PSAS scales. Each scar was compared before and after the treatment and with the skin in the corresponding healthy contralateral anatomical area at the same times. Results: Reduction of the scar surface wrinkling and overall scar flattening were demonstrated after the treatment. The scar slightly tended to approach the color and elasticity of healthy skin too. Conclusions: The combined local treatment of mature scars with low-intensity electromagnetic and electric stimulation in association with negative pressure might suggest a favorable synergic effect on the scar collagen and elastic fiber remodeling.

*M. Mendes Fossa Shirata, P. Maria Berardo Gonçalves Maia Campos, Evaluation of Young Skin Photoaging Using Biophysical and Imaging Techniques, Poster Presentation at ISBS Conference San Diego, May 2018*

Introduction: Photoaging is associated to an intense solar exposure, thus the photoaging signs can be observed also in the young skin, mainly in countries with high UV incidence, like Brazil. The aim of this study was to evaluate the skin changes resulted from photoaging in Brazilian young skin in comparison to photoaged mature skin. Methodology: Thirty participants were divided in two groups: the first between 18 to 35 years old and the second, 40 to 60 years old. Analyzes were performed on the randomized facial malar region. TEWL, stratum corneum water content, sebum content, high resolution imaging, echogenicity and dermis thickness, skin color and elasticity parameters were analyzed. Results and Conclusions: The obtained results showed that sun exposure can cause changes even in the young skin, with the appearance of spots and the reduction of the echogenicity of the dermis, besides there were no significant differences between young skin and mature skin in most parameters. In conclusion, signs of photoaging may be frequent even in young skin.

*D. Khazaka, C. Uhl, Nails: more than just skin extensions, PERSONAL CARE ASIA, May 2018, p. 33-35*

The horn-like envelopes covering the tips of our fingers and toes are called nails. They are highly specialised epidermal appendages. Finger- and toenails are made out of a tough fibrous protein, the alphakeratine. The nail consists of the nail plate, the nail matrix and the nail bed below it, and the grooves surrounding it.<sup>1</sup> Apart from the aesthetical aspect, a healthy fingernail has the function of protecting the fingertip and the surrounding skin from injuries and preventing the skin at the

end of fingers and toes from rolling backwards over the distal phalanx. The nail helps to improve sensitivity and the grip of the fingers and also enables the precise manipulation of small objects through counter-pressure exerted on the pulp of the distal digits (e.g. pulling out a splinter in one's finger), as well as certain cutting or scraping actions.<sup>13</sup>

*M. Portugal-Cohen, Z. Ma'or, M. Oron, Full Scale Customization, Cosmetics & Toiletries, Vol 133, No. 9, September 2018*

The drive for personalized consumer products is no longer a passing fad. Personalization stems from deep motivations. The emotional wish to purchase products created "especially for me" comes across with an understanding of diversity between individuals and the prospects for more effective solutions to meet each individual's special needs. However, efforts to introduce personalized skin care— i.e., for unique skin with distinctive characteristics — on an industrial scale means products formulated for generalized needs, which could not be as effective.

*D. Cobiella, L. Archer, M. Bohannon, D. Santoro, Pilot study using five methods to evaluate skin barrier function in healthy dogs and in dogs with atopic dermatitis, Vet. Dermatology, January 2019*

Background: Atopic dermatitis is associated with skin barrier defects. In people, noninvasive techniques are used to quantify the skin barrier functionality. In dogs, transepidermal water loss (TEWL), stratum corneum hydration and pH have been used to assess skin barrier function. However, few studies have determined their repeatability. Objective: To assess the repeatability of measurements of skin hydration, TEWL, pH, skin absorbance and erythema in healthy and atopic dogs. Animals: Fifteen healthy and 15 atopic privately owned dogs. Methods and materials: Three repeated measurements using Corneometer<sup>®</sup>, Skin-pH-Meter<sup>®</sup>, Colorimeter<sup>®</sup> and VapoMeter<sup>®</sup> were obtained from inguinal, axilla, pinna and interdigital space by three investigators. Intra- and interobserver variability (coefficient of variation, correlation coefficients and intraclass correlation coefficients) and difference between the two groups (*t*-test or Mann–Whitney U-test) were determined. Results: High repeatability and low variation were observed both intra- and interobservers for all devices except the VapoMeter<sup>®</sup>. The most repeatable device was the Skin-pH-Meter<sup>®</sup>, whereas the VapoMeter<sup>®</sup> was the device with the highest intra- and interobserver variability. Atopic dogs had a significantly increased pH (inguinal *P* = 0.03; axilla *P* = 0.02) and erythema (inguinal *P* = 0.01; axilla *P* = 0.02) compared to healthy dogs. No differences between the two groups were detected using the Corneometer<sup>®</sup>, VapoMeter<sup>®</sup> or Colorimeter<sup>®</sup> (tartrazine absorption). Conclusion and clinical significance: The results of this pilot study support the use of Corneometer<sup>®</sup>, Skin-pH-Meter<sup>®</sup> and Colorimeter<sup>®</sup> in the assessment of skin barrier function in dogs; further investigations to optimize measurements and confirm these results are needed.

*J.I. Yablonski, D.R. Winne, Beginner's Guide to Natural Organic – Product Safety, Claims Support and Preservation, Cosmetics & Toiletries, Volume 134, No. 2, February 2019, p. 18-31*

Browsing a cosmetic counter, searching online or tuning into home shopping networks, one cannot help but notice the ever-increasing number of cosmetic and personal care products purporting to be *green*, *natural* or *organic* that are obviously targeting the rapidly growing environmentally conscious consumer and spa markets. Entire sections of exhibitions and trade shows have been dedicated.

*C. Uhl, Efficacy testing of microbiome skin care, PERSONAL CARE EUROPE, April 2019, p. 41-45, PERSONAL CARE ASIA, May 2019, p. 51-55, косметолог 2 [94] 2019 (in Ukrainian), Cosmetics & Toiletries Brasil, Vol. 31, Mai-June, 2019, p. 22-27 (in Portuguese)*

For years now, we have accepted the idea that we can nourish our intestinal tract with dedicated bacterial ingredients from food supplements and thereby improve our general health. Books written on this subject have become bestsellers. But why should we focus only on our intestinal tract? There are so many different microbial communities that can be found on and inside our body. Especially the colonization of the skin being our largest organ, tangible to the hands, visible to the eye, and in constant contact with the outside environment has moved to the front of cosmetic research. The idea of being a complex ecosystem is adding to the existing trend of personalised cosmetics, and will confirm the customer in their feeling of uniqueness.

В течение многих лет мы принимали идею о том, что можем обогащать наш кишечный тракт специальными бактериальными ингредиентами из пищевых добавок и тем самым улучшать общее состояние здоровья. Книги, написанные на эту тему, стали бестселлерами. Но можем ли мы сосредотачиваться только на нашем кишечном тракте?

O microbioma cutâneo é a população de microrganismos que habita a pele. Neste trabalho, o autor apresenta uma breve descrição da importância da atividade do microbioma e dos meios analíticos instrumentais para medir a eficácia de produtos cosméticos de interesse do microbioma cutâneo.

*M.L. Vazquez-Gonzalez, G. Rodriguez, L. Rubio, J. Nestor, E. Fernandez, L. Barbosa-Barros, O. López, **Intelligent ageing repair with skin superfoods**, PERSONAL CARE EUROPE, April 2019, p. 157-162*

The many environmental factors related to modern lifestyle generate a skin imbalance that leads to premature ageing. In this study, we evaluate the capacity of a new skin delivery system based on bicosomes (named bicosome-xanthin) to provide intense detox and revert the signs of ageing. This system was specially designed to incorporate, stabilise and deliver microalgae extract into deep skin layers. Bicosomexanthin proved to be effective in protecting the skin against pollution particles and to prevent 90% of the damage caused by blue light. This extraordinary ingredient also proved *in vivo* to boost the skin's antioxidant capacity and barrier function, to accelerate epidermal cell renewal, improve skin brightness and firmness, and visibly reduce wrinkles.

*Y. Song, Y. Pan, H. Wang, Q. Liu, H. Zhao, **Mapping the face of young population in China: Influence of anatomical sites and gender on biophysical properties of facial skin**, Skin Res Technol. 2019;25: p. 333-338*

Background: Facial skin exhibits unique biophysical properties, which are influenced by anatomical regions and genders. The aim of this study was to comprehensively assess the regional and gender differences in facial skin biophysical parameters among Chinese population. Materials and Methods: The 12 skin biophysical parameters at four distinct facial skin sites (forehead, cheek, canthus and chin) were measured in a normal population (n = 212) with 42 males and 141 females aged 18-29 years living in Beijing. These parameters consisted of skin hydration, transepidermal water loss, sebum content, erythema/melanin indices, L\*a\*b\* color, skin gloss and elasticity, all quantifying with non-invasive instruments. Results: The results demonstrated that the characteristics of the facial skin were significantly different between the regions and genders. The forehead had weaker skin barrier function but secreted the most sebum content, while the cheek was the driest and brightest region on the face. The canthus was the most hydrated area and the chin displayed higher sebum secretion, darker skin color and less elastic. The females showed more hydrated, less oil, lighter and more elastic facial skin compared with males. Conclusion: This study indicates that the young Chinese facial skin significantly varies with face anatomical regions and differs between genders.