Nadine Pernodet, Ph.D., Vice President, Skin Biology & BioActives, R&D, Estée Lauder Companies

talks about how understanding skin helps for highly performant skincare products

Nadine Pernodet, Ph.D.

EURO COSMETICS: *Dr. Pernodet, could you tell us more about your education and professional background?*

Dr. Nadine Pernodet: Since I was very young, I remember I have always been curious and interested by science, any science, really. This led me to get a Ph.D. in Physical Chemistry at Louis Pasteur University in France. From there, I came to the US at Stony Brook University and the great thing there, was that I was able to collaborate with any groups, no matter which field they'd be …

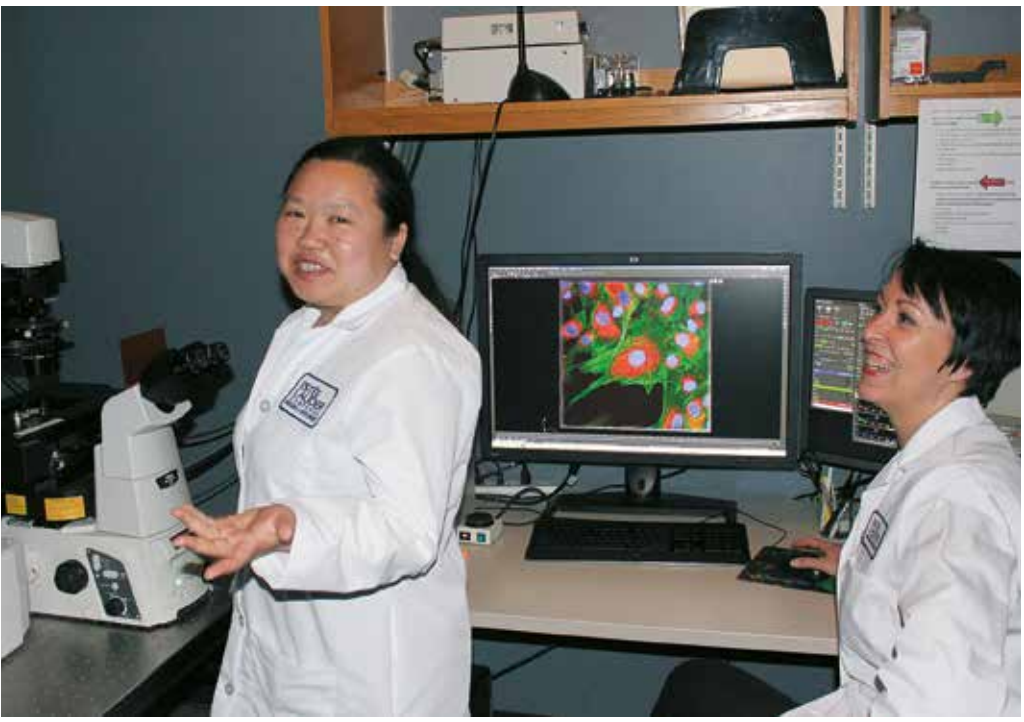
I became a Professor at Stony Brook University where we had many collaborations between Materials Science & Engineering, Dermatology, Biomedical Engineering, Orthopedics, Biology, Chemistry and Physics in Brookhaven National Lab. My research was mainly on skin and bone at that time. Interdisciplinary science has always been extremely exciting for me and logical as to explain what is happening in the body: biology, of course is critical, but all mechanisms can be related to chemistry and physics as well and could help to understand what is happening. We were able to get different grants to do our research. From this, I had to learn biology and skin biology in depth. And we were approaching it with a very different view, for example, how mechanical forces would affect cell behavior, through the field of mechanobiology & biomechanics … how this was affecting biomineralization in bones or aging in skin cells. Then, 10 years, ago, I joined the ELC R&D where I am now leading the Skin Biology & BioActives groups supporting all the brands of the company, where we have been at the forefront of the scientific research to bring the best and always move our products to higher performance.

EURO COSMETICS: *Which research are you doing with your Skin Biology & BioActives groups?*

Dr. Nadine Pernodet: In Skin Biology & BioActives, we are really inspired by the latest research being done in the Medical Field and with our high expertise in skin, we bring these latest areas to our skin research to develop high performance products through new bioactives/technologies that we develop to include in our products. To get a better understanding, we must continue to innovate at the intersection of health, science and beauty. Our research has been influenced by unprecedented biological breakthroughs, such as the mapping and sequencing of the human genome. But this created even more questions and led us to turn to Epigenetics research and really understand how the environment is influencing skin cells behavior and skin phenotype. For example, for over 10 years now, we have been studying the natural rhythm in skin, we are the experts in skin circadian rhythm in the industry and have shown how important this is to keep a healthy skin. Being in sync with the rotation of the earth and the natural day/night rhythm is part of our evolution and explains how we have adjusted to our environment and survived by maximizing different functions during daytime for protection and other ones during nighttime for repair and recovery. Our skin is made of millions of cells, imagine if each of them was doing whatever it wants, whenever it wants, this will result in chaos. Nature by timing exactly which function needs to happen with the synchronization between cells optimizes the protection, maintenance, repair and recovery of the skin. These mechanisms are extremely important to understand and to protect in order to keep a healthy/young skin.

Also, after learning from specific pathways we have discovered in the past; for the future, we are moving to a Systems Biology approach and looking for what we call "Master Pathway". For example, autophagy, which results in the benefits for so many different pathways, helping to decrease intracellular damages, inflammation and to increase repair and energy. Autophagy, which was last year's Nobel Prize in Medicine and was awarded to Dr Ohsumi for his work demonstrating the significance of autophagy into human health. In skin cells, we were the first ones to demonstrate the importance of autophagy in order to increase skin cells'repair and recovery, this was published few years ago.

In my group, really, we are interested by anything that potentially can influence skin and skin cells behaviors.



Dr Nadine Pernodet and scientist Kelly Dong in the lab.

EURO COSMETICS: *How does nature influence your work?*

Dr. Nadine Pernodet: Nature is a constant inspiration for us on many different levels on understanding how it is influencing skin, as we just talked about with the skin circadian rhythm but also as an inspiration to develop the most potent technologies and molecules. Nature has so much to teach us on how plants, for example, are able to produce highly potent molecules in a very sustainable way! The best chemistry is made by Nature.

In our latest research, we have collaborated with Dr Ilya Raskin, Distinguished Professor from Rutgers University, School of Environmental and Biological Sciences, and President of the Global Institute for Bio-Exploration in order to develop a potent botanical extract with high level of isothiocyanate. This molecule is well known by scientists to increase Nrf-2 activity (Nrf-2 being a "master" pathway, resulting in protection, reduction of damages and increase of repair) but is extremely difficult to find at high levels in plants and/or to keep stable. With our collaboration, Dr Raskin was able to develop a specific process for the plant to produce high levels but also be stable after extraction. We were able to show the high increase of Nrf-2 activity in skin cells (in-vitro) resulting in powerful activation of anti-aging pathways. Further, these cells exhibit strong endogenous and UV-induced antioxidant activity and powerful anti-inflammatory activity. We have presented this breakthrough in skin anti-aging research last year at the annual meeting of the Society for Investigative Dermatology (SID).

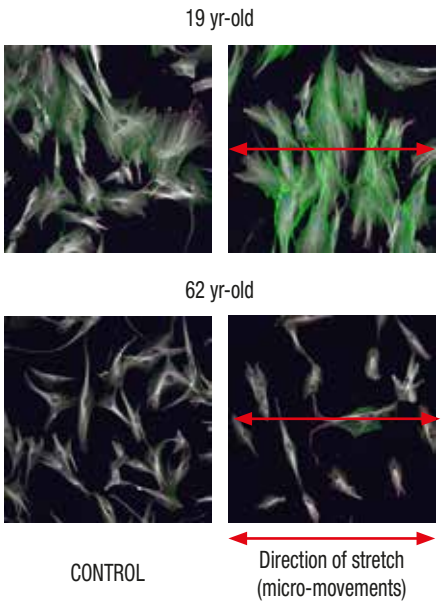
EURO COSMETICS: *What is your latest breakthrough and discovery?*

Dr. Nadine Pernodet: I have been fascinated and have researched in the world of biomechanics and mechanobiology for over 17 years now. The research at the interface of Physics and Biology is highly exciting.

The skin in particular is exposed to different mechanical properties over time resulting from aging process but also different mechanical stress, especially around the eye. The periorbital skin is under constant micro-movements due to daily facial expressions, smiling, laughing and crying. Even blinking, do you know we blink more than 10,000 times per day? And this is the minimum micro-movement that your periorbital skin is exposed to, every day! As a result, the periorbital skin cells are under constant changes in mechanical stress due to continuous stretching and release. The cells sense the strain (deformation) in the extracellular protein matrix (ECM) caused by these mechanical stresses and translate this information into very specific cellular responses. Although the molecular signaling and regulatory mechanisms are not fully understood, this constant feedback and cellular response mechanism between the external and internal forces have been demonstrated to have a strong impact on cellular behavior.

For us, it was important to understand the impact on skin cells around the eye and how their functions would be impacted, i.e. we used a model where we exposed the cells to mechanical tension and release using an average frequency close to the one of a blinking eye and followed cellular response from young and aging cells.

We show for the first time how skin cells respond and try to adjust to this constant micro-movement with accumulation of damages over time, translated in a decrease of collagen production, decrease of cellular proliferation and increase of inflammation (see figure).



Mimic of the constant eye movement for 24 hrs
Blinking rate: 15 pulses/minute

Scientists Krystle Corallo and Dr Klodjan Stafa in the Skin Biology lab.

Also, results show that over time, skin cells lose their ability to reorient in order to minimize the impact of this constant change of mechanical forces.
These stresses, induced by a profound level of repetitive tissue movements that impact skin cells and scaffolding, along with the unique structure of the periorbital skin, explain why eye skin ages faster than the surrounding facial skin.

EURO COSMETICS: *What trends did you create?*

Dr. Nadine Pernodet: We were the first ones to talk about skin repair many years ago (ANR).
We have been studying the influence of the environment & pollution for many years, through our research showing how pollution is influencing aging and pigmentation (this work has been published in collaboration with Dr Krutman).
We were the first ones to talk about the importance of Epigenetics in 2009: how the environment through epigenetics is influencing skin behavior and has the greatest impact on the aging process (~70%).
As well we were the first ones to introduce the importance of skin natural circadian rhythm and the importance of night for repair many years ago, in 2009 for ANR. It is well known that our body through evolution is following a day/night rhythm. In the same way, youthful skin is following this natural rhythm when we are young. During daytime, skin function is focused on protection against the environment, while nighttime skin function is focused on recovery, repair and getting ready for the next morning (we have few publications in this field as well as a chapter written for Harry's Cosmeticology books). Unfortunately due to aging, jetlag, pollution, … this rhythm is lost and this results in an accumulation of damages and loss of repair, which ultimately accelerates the aging process.
All of these as we know have been followed and are really strong trends in skincare for higher performance now.

EURO COSMETICS: *Thank you for talking with us.*