

AT A LOSS WITHOUT MOSS!

A conversation with Beata Hurst, Head of Sales DACH & Can, Mibelle Biochemistry about the peculiar features of the world's oldest land plant, moss, and new sustainable moss cell technology



Beata Hurst

EURO COSMETICS: *Mibelle won two gold awards for MossCellTec™ No. 1 at in-cosmetics Global 2018. The “Innovation Zone Best Ingredient Award” and the “BSB Innovation Prize”. What can you tell us about your new MossCellTec™ technology?*

Beata Hurst: There are at least 3 reasons why MossCellTec™ No. 1 is a real innovation:

1. it is the first active ingredient from **biotechnologically produced moss**
2. it offers a novel anti-aging concept: **cell nucleus health**
3. it improves skin hydration and homogeneity after just two weeks despite climatic changes and urban stress

EURO COSMETICS: *Mosses form thick green carpets on the forest floor and like to be damp. As the oldest land plant on our planet, they have an extraordinary structure. What distinguishes moss?*

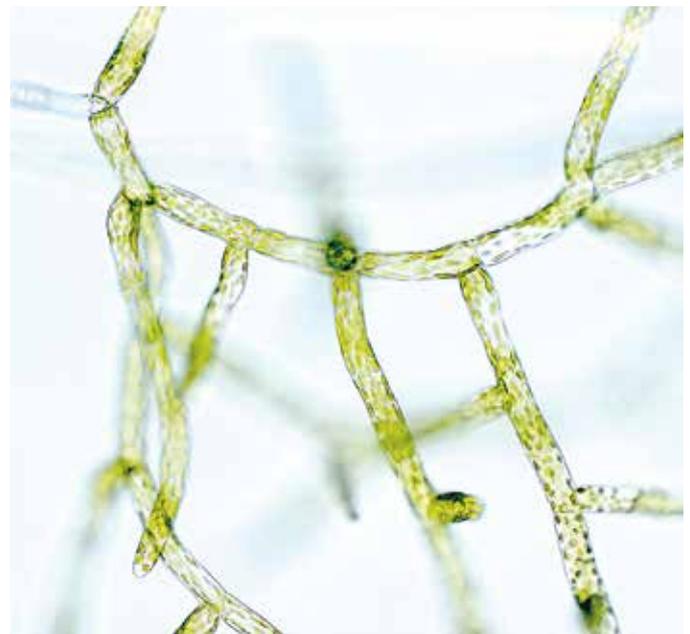
Beata Hurst: About 470 million years ago non-vascular land plants conquered the earth¹, amongst them the bryophytes comprised of hornworts, liverworts and mosses. Mosses are eukaryotic plants. Compared to higher plants, they have no flowers, roots or vascular tissues. Mosses can be found not only in forests but also in places where higher plants cannot survive due to temperature, altitude or the lack of soil, for example in the hot desert, in cold areas such as the tundra, in mountains 6000 m above sea level, on stones and even in cities on stone-flagged streets. Beside their resilience against direct sunlight, heat, cold and frost, they also possess distinct resistance mechanisms against microbial attacks. They can only cope with these huge environmental stresses due to their

pristine gene sets. This makes them resistant and versatile in comparison to the more specialized higher plants.

EURO COSMETICS: *How have you succeeded in using the properties of this special plant to your benefit?*

Beata Hurst: To use moss as a new raw material in cosmetic products poses a challenge, mainly because collecting mosses from nature is not sustainable as they grow slowly and are often crucial parts of an ecosystem or even protected by law (red list organisms). Furthermore, the lack of reproducibility in collecting identical species can lead to high variations in extractables and in worst case to out of stock situations. These are some of the reasons for the lack of a moss products being used as a cosmetic ingredient so far. (The most famous Irish moss for example actually is a red algae and the Iceland moss is a lichen, even if both are often perceived as mosses). Additionally, since wild mosses filter the air and retain toxins it restrains the use of them for cosmetics.

Therefore, an innovative biotechnology to grow moss cells in a laboratory setting was developed: MossCellTec™. This technology is based on the capacity of moss cells to divide after the fragmentation of its leaves (asexual reproduction). Cells from the *Physcomitrella patens* moss were harvested and cultivated in the protonema stage (germinating spore). Finally, in order to obtain all valuable water-soluble ingredients out of the protonema culture we developed a new cold pressing (>200 bar) extraction method.



Protonema Stage of *P. Patens*

EURO COSMETICS: *And what advantages does this new technology provide?*

Beata Hurst: MossCellTec™ is a novel technology that, for the first time, enables the large scale cultivation of moss cells in sterile conditions and in both a reproducible and sustainable way. Indeed, this process requires a small quantity of plant material just once.

EURO COSMETICS: *To combat skin aging, the cell nucleus and its vitality play a crucial role in MossCellTec™ No. 1. Can you tell us a little more about this?*

Beata Hurst: The intact structure of the cell nuclear envelope and the efficient transport of molecules through the nuclear pores are important factors for skin cells. This novel anti-aging concept can be summarized as cell nucleus health.

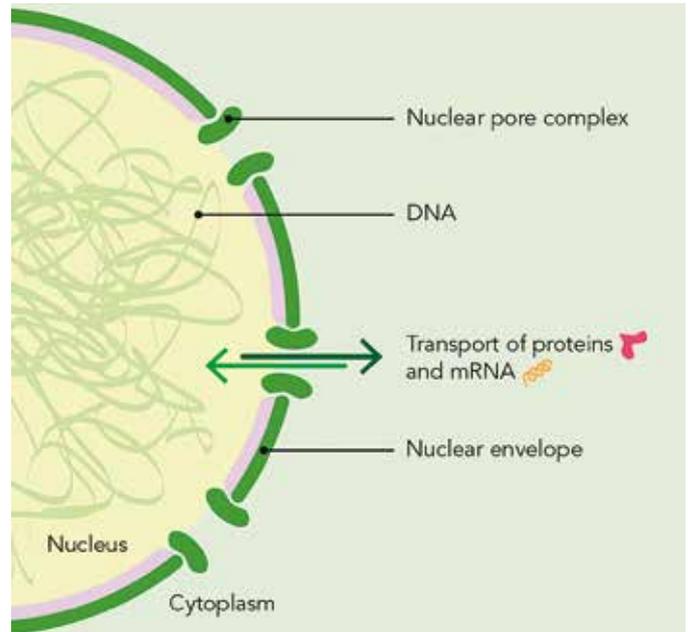
The cell nucleus contains the DNA, the blueprint of the cell and is therefore considered the control center of the cell. It is surrounded by a membrane called the nuclear envelope, which contains holes, the nuclear pores, through which traffic into and out of the nucleus takes place. Only small molecules can freely diffuse through the nuclear pore complexes. Larger molecules such as proteins and messenger RNA complexes need to be actively transported to reach their destination. This transport process is highly complex: In a single human cell, there can be up to 5,000 nuclear pore complexes and each can transport 1,000 molecules per second. This means that in one cell, up to 5 million molecules are transported into and out of the nucleus every second.

EURO COSMETICS: *What is the significance of the cell nucleus for our aging?*

Beata Hurst: Timely transport of signaling molecules is crucial for the adaptation of cells to fast changes in temperature and humidity. This is especially true for skin cells that are in close contact with the environment. As we age, the transport becomes less efficient and less selective which can lead to less resilient skin.

For a long time it was believed that the function of the cell nucleus is merely DNA storage and that the nuclear envelope is just a hull to contain the genetic material. This is far from the truth: Recent research on premature aging diseases has shown that the correct composition of the nuclear envelope is essential for the maintenance of nuclear shape, DNA stability and regulated gene expression.

Recent studies have shown that RanBP17 (Ran binding protein 17), which is a transport protein that enables and controls the flow of molecules through the nuclear pore, is reduced with age in several cell types, including fibroblasts and neurons. It was also shown that this decrease influenced various important aging processes. This highlights the important role of RanBP17 and the nuclear transport process in aging regulation. As well with aging, the expression of lamin A and LAP2 is reduced. These proteins confer mechanical support (structure, stiffness and resistance to deformation) to the nuclear membrane, maintain the shape of the nucleus and plays a role in several cellular processes.



EURO COSMETICS: *What studies have you done about this?*

Beata Hurst: The ability of MossCellTec™ No. 1 to protect the structure and activities of the cell nucleus from aging was evaluated by measuring its effect on the above mentioned genes. These genes were selected because of their important role for the nuclear structure and the transport of molecules through the nuclear pores.

Firstly, the expression of these genes was analyzed using quantitative PCR on normal human epidermal keratinocytes that were isolated from both a young donor (a 20 year old woman) and an older donor (a 55 year old woman).

Secondly, the keratinocytes from the older donor were either treated or not (control) with different concentrations of the moss extract and as well analyzed using quantitative PCR.

EURO COSMETICS: *And what have the tests shown?*

Beata Hurst: Results confirmed that the expression of LMNA, LAP2 and RANBP17 were decreased in the "older keratinocytes" compared to the younger ones. However, MossCellTec™ No. 1 was shown to improve the expression of these important cell nucleus health markers involved in the nuclear envelope structure and transport into and out of the nucleus in aged cells.

EURO COSMETICS: *And how can the active ingredient help with skin care?*

Beata Hurst: By maintaining an efficient transport of the molecules into and out of the nucleus and by preserving the organization of the nuclear envelope, the communication inside the cell is optimized and cells can adapt more quickly to the ever-changing environment, making our skin more resilient to aging factors.

EURO COSMETICS: *In addition to anti-aging properties, MossCellTec™ No. 1 also protects against climatic conditions that*

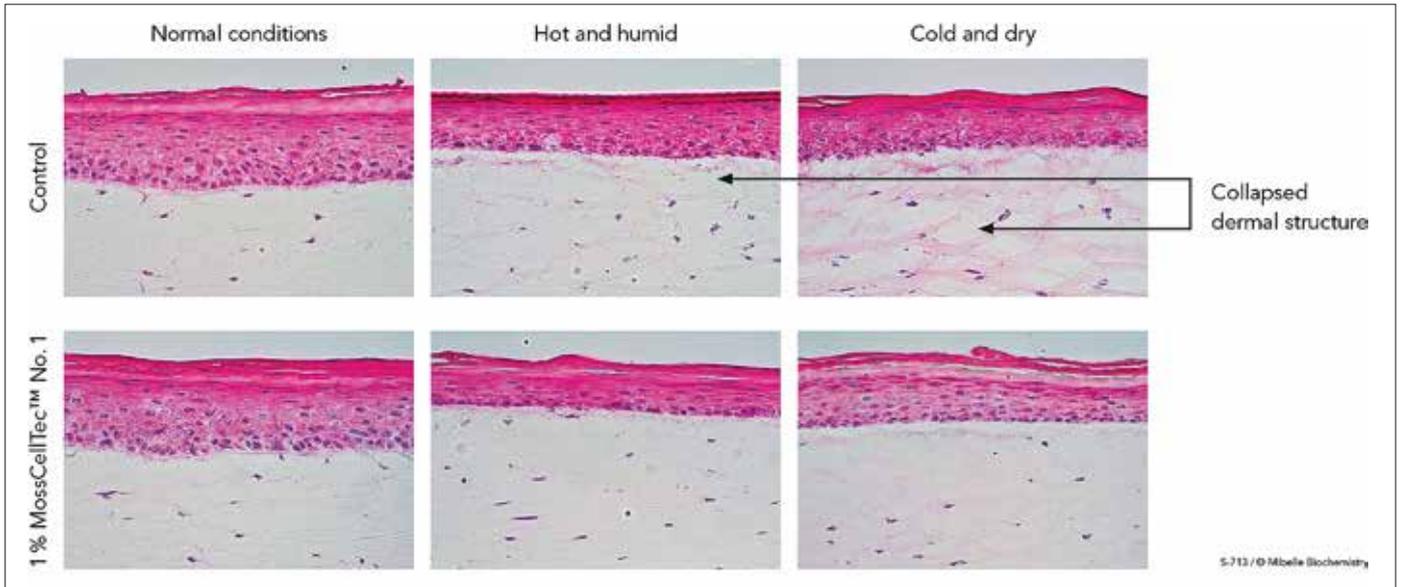


Figure 1: Skin adaptation to environmental changes hot-humid conditions: 40°C, 80% relative humidity (RH), 30 minutes, cold-dry conditions: 10°C, 40% RH, 15 minutes. Hematoxylin-eosin staining. – Abbildung 1: Anpassung der Haut an Umweltveränderungen (warm-feuchte Bedingungen): 40°C, 80 % relative Luftfeuchtigkeit (rF), 30 Minuten (trocken-kalte Bedingungen): 10°C, 40 % rF, 15 Minuten. Hämatoxylin-Eosin-Färbung.

damage our skin. What are these conditions and what results were achieved here?

Beata Hurst: Various *in vitro* and placebo-controlled clinical studies showed that MossCellTec™ No. 1 helps the skin to adapt to fast climatic changes (cold/hot, low/high relative humidity). This results in a significant increase in skin hydration, homogeneity and barrier function despite stressful conditions well as a wrinkle reduction within a short time frame. One of the placebo-controlled clinical studies was performed on a panel of Korean women who spent more than 2 hours per day outside in the summer in Seoul. After 14 days of treatment with 2% MossCellTec™ No. 1, a significant improvement of skin hydration, TEWL and skin tone homogeneity compared to placebo was observed.

Another example to demonstrate the protective effect of MossCellTec™ No. 1 is the study on reconstructed skin, exposed to hot-humid and cold-dry conditions (Fig. 1). Skin treated with MossCellTec™ No. 1 showed superior adaptation to environmental

changes in comparison to untreated skin. The disrupted collagen structure (Fig. 1, stained) cannot compete with the resilience of the treated sample.

EURO COSMETICS: How did customers receive your groundbreaking new biotechnology?

Beata Hurst: As MossCellTec™ No. 1 captures the resilient properties of a totally novel ingredient source – moss – and as it is the first active to target the novel life science topic cell nucleus health it is considered as a real break-through in anti-aging skin care. Great feedback we get as well for the sustainable production of moss through the novel biotechnology and the fact that this ingredient is alcohol-free, preservative-free and COSMOS approved.

1. R. Reski, *Enabling the water-to-land transition*, *Nature Plants*, DOI: 10.1038/s41477-018-0101-5 (2018)

EURO COSMETICS: Thank you very much for the conversation.

