

# Nitrogen – a driving force

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With a ratio of 78 per cent, nitrogen is the most important element in air. A multitude of its compounds can be found in skin care preparations.

About 78 per cent in volume or in other words the major part of our atmosphere is made up of the colourless and inodorous nitrogen (N). With its 0,03% share in the earth's crust nitrogen rather is a rare element on our planet, though. In contrast to the oxygen, we inhale the diatomic gas (N<sub>2</sub>) as a component of the air but we also exhale it unmodified. Yet still a large part of our body consists of compounds of nitrogen with other elements. How this came about is a fascinating chapter in the history of the earth and the evolution of life.

## Zero hour

Initially the atmosphere and surface of the earth consisted of gases and inorganic liquids and minerals that reciprocally interacted in chemical reactions and physical effects. The impact of radiation and electric discharge played a decisive role here since the inert nitrogen was thus activated to combine with other elements. Based on the random principle, the earliest **amino acids** could develop among other substances or in other words, molecules consisting of carbon, hydrogen, oxygen and nitrogen.

## Autocatalysis

The newly formed molecules had also been chemically reacting among each other. The amino acids linked together to form **peptides** (amide family). A particular feature of the oligopeptides, consisting of a few amino acid modules, and still more of the polypeptides with their numerous amino acid subunits is to accelerate chemical reactions. In other words: peptide structures have catalytic effects. In the case of amino acid reactions into more and more complex peptides this process is called autocatalysis.

## Hand in hand

The peptides were able to catalyse chemical reactions and to reduplicate. This gradually paved the way for the formation of the precursors of **enzymes**. The most successful among them produced substances that again could

either be modified or degraded or further synthesized by other enzymes. They further coordinated in order to gradually work hand in hand, according to the mass action law. With progressing degree of organisation, specialised structures developed that could replicate themselves. They are considered to be the preliminary stages of life. Today our genes precisely are the organizational key for any and all the enzymes and their finely tuned activities formed later in our body.

## Synergies

This is the reason why our organism depends on the intake of nitrogen-containing amino acids, peptides including specific proteins, and of vitamins. We are at the tail of the food chain that starts with the **bacteria** that live in the water, in the soil or in symbiosis with plants and that in the course of millions of years have learned to fixate the nitrogen of the air with the help of enzymes. And there is more to it: our organism could not work without the synergies with the microorganisms of the gastro-intestinal tract and the skin. They all work with the same tools, that is to say the essential nitrogen compounds.

## Skin care

At the beginning of the 20th century, the chemical industry finally managed to catalytically sequester the atmospheric nitrogen and subsequently synthesize myriads of its compounds. And this is the reason why a multitude of these substances can be found in skin care products. There is no surprise, though, that these are the same substances that played a role in evolution.

## Amino acids

Amino acids are the main components of the NMF (Natural Moisturizing Factor) and work as effective radical scavengers by intercepting nitrogen oxide radicals of the air, among others, and transforming them into harmless atmospheric nitrogen. A sound NMF is a basic requirement for the osmotic balance and a smoothly working skin barrier.

Ectoin is a water-binding cyclic amino acid and occurs in bacteria that also can live in saline lakes under high osmotic pressure. Ectoin improves the irritation threshold of the skin and is used, frequently in liposomal form, in preparations applied for sensitive skin.

### Amides

With their hydrogen bridge bonds amides adhere well to the skin surface. Certain amides such as the ceramides even have barrier-active effects. It involves an anti-itching effect which however is more pronounced with urea, allantoin and fatty acid alkanolamides such as palmitic acid ethanolamide. High concentrations of urea have a keratolytic effect and enhance the penetration of other substances.

Ceramides impede the dehydration of the skin and the penetration of foreign substances.

They are usually applied in the case of dry skin and in the context of skin protection. In the hair care, ceramides are integrated into the inter-spaces between hairs.

The amides capsaicin (chili) and spilanthol (paracress) belong to the pungent substances. They have local anaesthetic effects and so reduce the muscle contraction of the facial lines which leads to an effective smoothing of wrinkles. Hyaluronic acids are related to the polysaccharides and have a high water retaining capacity as well as a skin smoothing effect.

### Peptides

Various short-chained peptides are used as collagen boosters (matrikins) and botox-like wrinkle-smoothing tools. Enzyme peelings cleave the peptides and proteins and stimulate the skin renewal. Collagen- and wheat protein hydrolysates and their condensates smooth the skin similar to hyaluronic acid by forming hydrogen bridges to the keratin. Growth factors are natural peptides of the body that can be stimulated with the administration of vitamin A.

### Vitamines

Vitamin B<sub>1</sub> (thiamin), vitamin B<sub>2</sub> (riboflavin), vitamin B<sub>3</sub> (niacin), vitamin B<sub>5</sub> (pantothenic acid), vitamin B<sub>6</sub> (pyridoxine), vitamin B<sub>7</sub> (biotin), vitamin B<sub>9</sub> (folic acid) and vitamin B<sub>12</sub> (cyanocobalamin) without exception contain nitrogen atoms in the form of amines and amides. Provitamin B<sub>5</sub> (D-panthenol) has anti-inflammatory and penetration-enhancing effects; the latter-mentioned is used in facial tonics and above all in mask treatment products.

### Further nitrogen compounds (a selection)

**Dimethylaminoethanol (DMAE)** is ascribed to have wrinkle-reducing and moisturizing effects. The substance occurs as a metabolite of the phosphatidylcholine-bound choline, among others.

**Phosphatidylcholine (PC)** is a phospholipid with a many-faceted spectrum of activity and, besides the sphingomyelins and ceramides, belongs to the essential membrane-forming natural substances.

The **alkaloids** are a heterogenic nitrogen-containing substance group which, besides nicotine and morphine, also comprises caffeine (also used in cosmetic applications) and the anti-inflammatory berberine.

**Nitrogen monoxide (NO)** and **nitrogen dioxide (NO<sub>2</sub>)** develop after electric discharges and in the context of combustion processes. In the body nitrogen monoxide is released in controlled conditions as a neurotransmitter. Nitrous oxide (alias laughing gas - N<sub>2</sub>O) also is a nitric oxide however not a radical. It has anaesthetic effects. Nitrosamines are the reaction product of secondary amines with nitrogen oxides. They are considered to be cancer-triggering substances.

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