Nucleotides and the immune response

Dr Peter Koeppel explores the importance of nucleotides in supporting a strong immune response, while examining their role when it comes to vaccinations.

For more than a year, a Coronavirus has been keeping the world on its toes. This pandemic has shown that infections can push even our advanced health system to its limits.

While many Coronaviruses are harmless and often only lead to a mild cold, the new virus can mainly cause respiratory diseases, with symptoms such as cough, cold, sore throat, congestion and fever, but also severe breathing difficulties, pneumonia and high fever. It is the elderly or patients with weakened immune systems who are affected the most.

Virologists emphasise that viral infections, for example, influenza and Corona, have no consequences for people with a healthy immune system and can heal on their own. Therefore, strengthening the immune system can be an effective protection against viral infections.

But how can you specifically strengthen your own immunity to build up effective protection against infections? In the event of an infection, certain cells of the immune system recognise the foreign body, for example, a virus. The number of these defence cells must be drastically increased in a short time to fight the virus quickly and efficiently. For the cells to multiply quickly, however, all the basic building blocks of a cell must be available in sufficient quantities.

For the most effective multiplication of immune cells, the sufficient presence of nucleotides, the building blocks of our genetic material, is crucial. It is, of course, already known that the availability of certain minerals and trace elements (zinc, iron, selenium and manganese), as well as vitamins (C, E, D and B vitamins) are necessary to strengthen immunity.

What are nucleotides?

Nucleotides are small biological compounds that play an important role in almost all biological processes.

They are best known for their function as basic building blocks of DNA and RNA. From the simplest microorganisms to the giant trees, from the simplest animals to humans, all rely on DNA for their existence. The DNA contains the entire instructions for the cell and for the entire organism. A sufficient pool of basic building blocks, the nucleotides, is vital. An insufficient nucleotide pool can lead to serious failures in the organism.

The nucleotides intervene in the metabolism of the body at various stages. The main tasks of nucleotides include the following:

- **Nucleic acid precursors:** Nucleotides are the monomeric units of DNA and RNA.
- **Energy transfer molecules:** Adenosine triphosphate (ATP is the main source of cellular chemical energy).
- **Physiological mediators:** Cyclic adenosine monophosphate (cAMP) acts as second messenger; cyclic guanosine monophosphate (cGMP) regulates many cellular events; adenosine is known as a potent vasodilator; guanosine triphosphate (GTP) is involved in signal transmission, etc.
- **Activated intermediates:** For example, uridinediphosphoglucose (UDP glucose) is an intermediate product in glycogen and glycoprotein synthesis, and other nucleotides are intermediate products in the synthesis of phospholipids and serves as methyl sulphate donators.
- **Coenzyme components:** Such as nicotinamide adenine dinucleotide (NAD), flavin adenine dinucleotide (FAD) and coenzyme A (CoA) are involved in many pathways.
- **Cellular agonists:** Extracellular nucleotides trigger intracellular signaling transmission cascades, including the cAMP pathway.

All these functions of nucleotides play a crucial role in the fight against infections.

Infections:

Despite great advances in all areas of therapeutic medicine, infection is still a major cause of death in people whose immunological defences are weakened. Infectious diseases are

usually caused by microorganisms that invade the body and multiply (1). After attacking the body, microorganisms must multiply to cause infection (2). Once multiplication begins, one of three things can happen:

- The microorganisms continue to multiply and overcome the body's defences.
- An equilibrium is reached that triggers a chronic infection.
- The body destroys the attacking microorganisms – with or without medical treatment.

The invasion of a person by microorganisms begins when they attach to cells in the body. Whether the microorganism stays near the site of invasion or spreads to other areas and how severe the infection is depends, among other things, on how well the person's immune system works. When the immune system is not functioning well (this condition is called immunocompromised), people are more susceptible to infection.

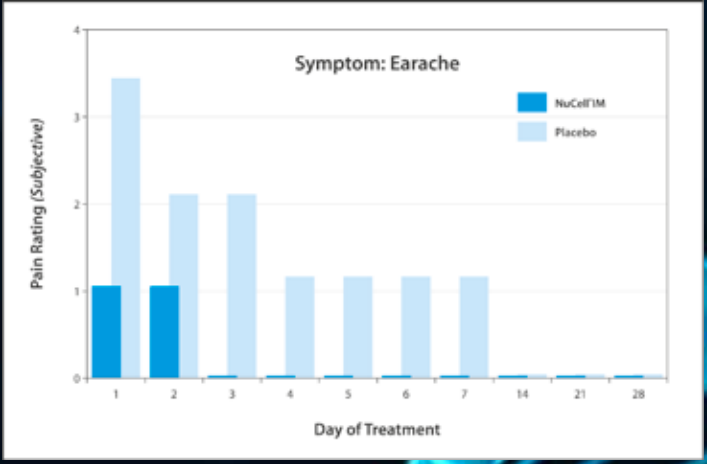
Normally, the skin prevents microorganisms from entering unless it is damaged. Mucous membranes are also effective barriers. Their secretions repel microorganisms. If microorganisms penetrate these barriers, they are quickly destroyed by the immune system, usually without anyone noticing. Only if too many microorganisms have penetrated, for example, through a wound, or if the immune system is weakened, can the pathogen spread in the body and cause an infection.

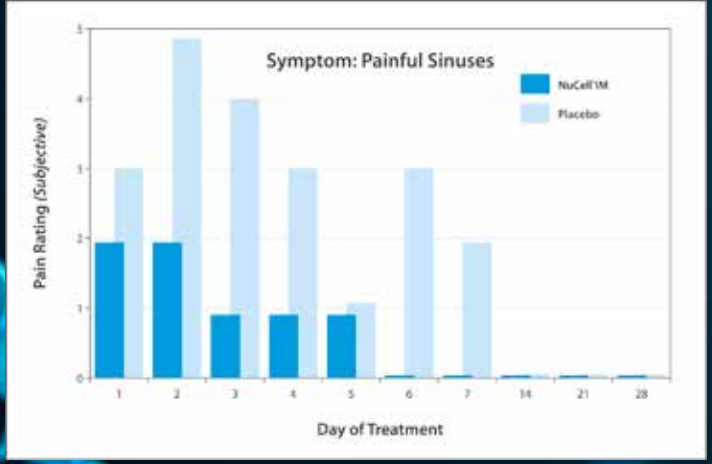
At that point, the immune system reacts by producing various substances or cells against the invading microorganisms and finally destroys them. Macrophages migrate to the site of infection and begin to render the microorganisms harmless. They express some parts of the pathogens on their surface and thus activate the specific immune system. Specific B and T cells are newly formed, which release substances that kill the pathogens or form antibodies.

Antibodies are important components of the immune system. They mark and inactivate microorganisms and make them more recognisable to the immune cells.

A particularly important component of the innate immune system are the so-called natural killer cells. They are specialised in recognising and destroying, especially virus-infected body cells. This combined defence force usually succeeds in destroying the invading microorganisms.

The reaction of the immune system to foreign organisms such as bacteria or viruses is influenced by various factors. It can be suppressed or slowed down by diseases or stress (3). Importantly, it can also be supported. Diet, for example, has a significant influence on the functionality of the immune system. It is known that certain dietary components are involved in the immune defence, even if only indirectly. The best-known representatives are probably the





two antioxidants, vitamin C and vitamin E. But zinc and selenium, for example, as well as protein and fat from food, are also important for the immune system. It is clear that nucleotides have an outstanding effect on the immune system.

A sufficient supply of nucleotides ensures optimal functioning of the immune defence, even against infections. More defence cells are produced, and the antibody production also develops more effectively.

Various publications demonstrate the positive effect of orally administered nucleotides on the immune system and their potential in bacterial and viral infections (4). Additional nucleotides are considered necessary for various physiological stresses, including growth and development, recovery from injury, infection, and certain disease states (9). Further experiments have also shown that nucleotide supplementation increases lymphocyte proliferation, macrophage activity and antibody production (6).

A specific clinical study (7) investigated the efficacy of its own 'combined' nucleotide formula in influenza. The results suggest that nucleotide supplementation, when used to treat cold symptoms, may reduce the severity of certain symptoms, such as sinus pain, earache and decreased taste, especially in the early stages of infection.

The trial at the university in Edinburgh (7) confirmed the results observed in animal trials. In a double-blind, randomised placebo-controlled study, students with an existing cold received either a placebo or a nucleotide supplement. Various parameters were measured, including painful sinuses or taste, daily for 28 days. All parameters improved significantly faster in the nucleotide group and these students were symptom-free after three to four days, while students in the placebo group still showed full symptoms after seven days. Although the sense of taste in the nucleotide group was worse on the first day, people recovered after only four days, while in the placebo group, people still felt a reduced sense of taste after 14 days.

Studies show that an intake of nucleotides through appropriate supplements is of paramount importance for human health, especially in view of the increasing number of viral and bacterial diseases.

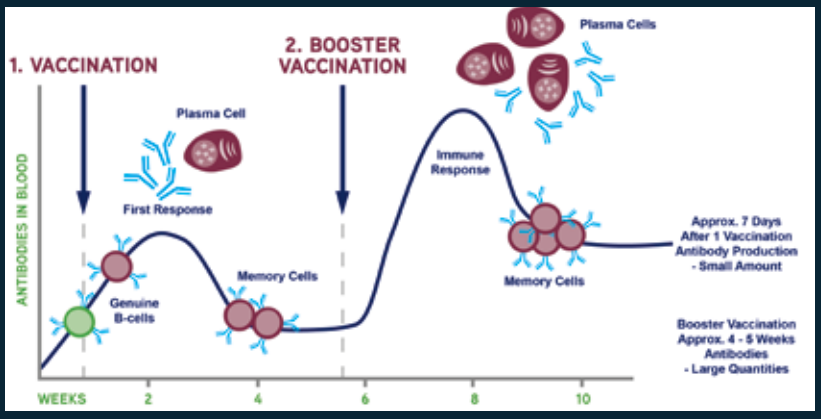
Effect of nucleotides on vaccination

Vaccination is intended to help the immune system of the vaccinated person to develop a specific immune response against certain pathogens. Vaccinations are designed to enable the immune system to recognise the antigens (attenuated or killed pathogens or components thereof) contained in the vaccine and to respond to them by producing antibodies and activating defence mechanisms by cells to eliminate these antigens. In addition, the creation of an immunological memory (through 'memory cells') ensures that in future, when the real pathogens enter, the body's defences are either strong enough to block infection from the outset or to prevent the disease.

An important step in immune defence is the formation of antibodies. In a trial, a normal vaccination was administered in the control group. The experimental group received for 60 days orally given nucleotides. The supplementation was started 14 days prior to vaccination up to day 60. The results of this experiment clearly show the effect of nucleotides on vaccination; even the first immune response is significantly higher than the one in the control. The titres are more than three times higher, which means that even at this stage, protection against infection is highly effective, whereas in the control, without nucleotides, protection is very weak. At the same time, more memory cells are formed and thus a long-term protection is formed.

Despite this already stronger immune response, there is a stronger increase in antibodies after the second vaccination, which, in turn, leads to the formation of more memory cells and even increases long-term protection.

This trial, and a series of other trials, clearly show that nucleotides significantly improve the protective effect of vaccinations and clearly contribute to better protection.



Dr Peter Koeppel has a PhD in Biochemistry and Immunology. He trained in biochemistry, with a special interest in clinical immunology, at the Institute of Virology at the University of Zürich. For over 20 years, Dr Köppel led the research and production of specialised naturally extracted nucleotide ingredients, conducting over 400 trials for animal and human health. This led him to being recognised as one of the world's foremost experts on nucleotides for health and performance.