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HUMAN LIFE SAFETY WITH THE DEVELOPMENT OF NANOTECHNOLOGIES

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Анотація

Розглянуто дослідження, які пов'язані з впливом наночастинок на організм людини. Описано можливі шляхи проникнення даних частинок до організму людини. Наведено аналіз зростання кількості видів нанотехнологічної продукції на ринку України.

Ключові слова: наноматеріали, наночастинки.

Abstract

Studies related to the effects of nanoparticles on the human body are considered. Possible ways of penetration of these particles into the human body are described. The analysis of the growth of the number of types of nanotechnological products on the Ukrainian market is given.

Key words: nanomaterials, nanoparticles.

Introduction

Today, there are major changes in the sphere of high-tech trends and information technologies. These changes are associated with the results of scientific research aimed at creating materials and devices whose dimensions are in the nanometer range (1 nm = 10^{-9} m), which are successfully used in the field of industrial technologies and diagnostic equipment. The development of nanotechnology is the beginning of the third scientific and technical revolution. In 60 countries of the world, there are programs for the development of nanoscience and nanotechnology [1].

Research results

Now nanoparticles are used in many industrial products, in particular in detergents, lacquers, surfaces, catalysts and car tires, solar cells and microelectronics components. Without them, it is impossible to imagine modern medicine. The industry needs more and more of them. Nanoparticles found in hundreds of purchased goods can cause significant harm to human health, because they can pass through the usual protective barriers of the body: gastric, placental, and blood-brain.

To date, there is already a developed assessment of the impact of new high-tech materials, which has a huge impact on the psychosomatic and functional state of a person, as well as the natural environment [2-4].

Scientific research has shown that nanoparticles can cause huge damage to health [5-6]. There are four ways for nanoparticles to enter the human body – through the lungs, olfactory epithelium, skin, and gastrointestinal tract. The lungs are the most accessible for nanoparticles. They consist of two different parts – the Airways that transport air to the lung tissue (tracheobronchial and nasopharyngeal regions), and the components of the lung tissue, the alveoli, where gas exchange occurs. Human lungs contain about 2,300 km of Airways and 300 million alveoli. The total surface of an adult's lungs is 140 m^2, which is larger than a tennis court. The Airways are well protected from the penetration of large particles due to the active epithelium and the viscous mucus layer on its surface. But in the gas-filled alveolar region, the barrier between the alveolar wall and the capillaries is very thin, only 500 nm and easily permeable. Substances that are not dangerous become dangerous to health when fat is dispersed. One example is "zinc" fever, which is formed when zinc is burned, after which aerosols of zinc oxide are inhaled. After nanoparticles enter the body, various diseases begin to develop. As a rule, the cells and tissues of our body get particles smaller than 20-30 nm, after which there is an accumulation of nanoparticles in the nucleus and cytoplasm of cells, then there is a violation of the protective systems of cells. Typically, nanoparticles enter the body through the respiratory tract. Thus, a person passes about 20 m3 of air through their lungs every day along with nanoparticles contained in the atmospheric air [7]. Huge harm to health occurs after inhaling carbon nanoparticles, which are usually formed when diesel or other fuel is not fully burned in motor engines, power plants, and especially during Smoking. Mechanisms of protection of the human lung system can not

completely cope with carbon dust, and it is quite easy and fast enters the human lung system, and from there nanometer carbon particles are carried through the blood system throughout the body. How to remove nanoparticles from the body is still unknown, but nanoparticles can appear after 40 or more years [8].

The destructiveness of nanomaterials for the human body does not end with acute respiratory pathologies of the lungs. The carcinogenic effect of widely used asbestos fibers in building materials, which can provoke malignant tumors of the pleura and peritoneum (silicosis), was revealed. After inhalation of nanoparticles of beryllium oxide, there is a gradual development of the disease the lungs and bronchial system, which is often the cause of death (Berlioz).

Thus, the chemically inert and safe polymer fluoroplast used in the manufacture of tableware can cause various pathologies and death of organisms. It is shown that the polymer fluoroplast (with a diameter of 26 nm) sprayed in the atmospheric layer in the form of nanoparticles at a concentration of 60 micrograms/m^3) can cause death in rats (causes blockage in the lungs of animals). It has been proven that Teflon nanopyl is more toxic than substances nervously-paralytic action [9].

Also, titanium dioxide, a white dye that is traditionally considered non – toxic, poses a threat to health. In the form of a fine powder, it is used in the manufacture of many sun creams, because it is able to absorb ultraviolet radiation. Researchers have found that the dioxide nanoparticles contribute to the formation of certain chemicals inside the cell that protect during short-term release, but with a longer duration of action, they pose a serious danger to the cell's regeneration.

According to research by specialists from the Massachusetts Institute of technology and the Harvard school of public health, some nanoparticles can affect human DNA [10].

Nanoparticles added to food, cosmetics, and materials used to make clothing can accumulate in tissues when ingested and release free radicals that damage DNA. To study this effect, scientists conducted experiments with five nanoparticles: silver, silicon dioxide, and zinc, iron, and cerium oxides. Human blood cells and ovarian cells of Chinese hamsters were used as tissues to check the activity of toxins.

Using CometChip technology, experts examined the effect of nanoparticles on two types of cells that are standard for toxicity studies: human blood cells of the limphoblastoid and ovarian cells of the Chinese hamster.

Zinc and silver oxide caused the greatest DNA damage in both cell lines. The concentration of 10 mg/l is not high enough to kill all cells, but it causes a large number of breaks in the single-cell DNA. Silicon dioxide, which is usually added in food and drug production, caused very minor DNA damage, as did iron and cerium oxides. With food residues, harmful substances end up in solid household waste, which is transported by garbage trucks [11-14] to landfills [15-17] and can further pollute the environment [18-21].

In order to determine exactly how metal oxide nanoparticles affect the human body as a whole, additional research is needed. Scientists believe that the effect depends on the dose, which means that it is necessary to find out at what concentration the negative effects begin to appear. They also believe that children and embryos are potentially more at risk from contact with nanoparticles, as their cells divide more frequently, making them more vulnerable to DNA damage [22].

Detailed Toxicological and hygienic characteristics of new nanomaterials this is a complex process that requires months and experts, as well as expensive equipment and many laboratory animals. Figure 1 shows the number of types of nanoindustry products.

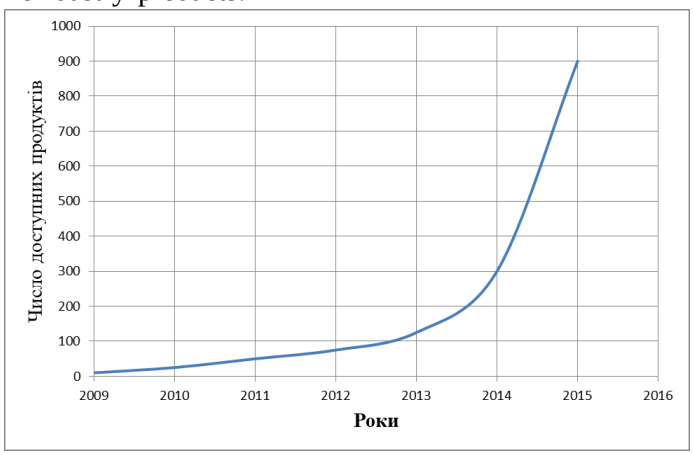

Figure 1 – Dynamics of growth in the number of types of nanotechnological products in the field of food production in the Ukrainian market for 2009-2015.

The Wilson Center created a database of nanoparticle applications and consumer products. There are 1,628 products listed, and 383 of them use silver nanoparticles. One of the most common elements is titanium and 179 positions. Nanoparticles can be found everywhere, even in personal hygiene items (toothpaste, cosmetics, nutritional creams), as well as in food dyes, additives, and the like [23].

Nanotechnology offers possible benefits. A project was also created to study the impact on human health and risks after development, as well as to manage them.

Conclusions

Thus, the widespread use of nanomaterials in the world can lead to unpredictable consequences. Proponents of nanotechnology must prove that their products or materials are safe before they are put into General use. First, you need to make sure that they are safe for humans and the environment.

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