UDC 620.3: 636.09

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Nanotechnologies and their application in animal husbandry and veterinary medicine

Goal. To analyze the results and prospects of the development of research on nanotechnology and the application of nanomaterials in livestock and veterinary medicine. Results The coordination role of the National Academy of Agrarian Sciences of Ukraine and the Institute of Animal Biology of the National Academy of Sciences of Ukraine on the implementation of nanobiotechnological research in livestock is shown. Investigated: use of chelates (based on nanoparticles of biogenic metals) in feed additives; application of nanobiotechnological methods for diagnosing animal diseases; construction of nanosilver drugs and vaccine adjuvants; influence of nanoparticles of metals on gametes viability, reproductive function and resistance of animals to animals. Conclusions The development of the Ukrainian agrarian sector should be based on the introduction of the latest developments of domestic scientists in nanotechnology in livestock and veterinary medicine.

Key words: nanotechnologies, nanobio materials, trace elements of trace elements, nanoliki.

Nanotechnology is a collection of methods and methods for manipulating matter at the atomic and molecular levels for the purpose of manufacturing end products with predetermined properties. Nanomaterials are ultrafine materials containing structural elements (grains, crystallites, blocks, clusters) whose geometric dimensions at least 100 nanometer in size do not have qualitative new properties, functional and operational characteristics. The main task of nanobiotechnology - the creation of new materials - modified biosystems and methods for the study of bio- and nanoprocesses. Future of nanobiotechnology in agriculture, in particular in creatures, not in nanoparticles, but in functional nanobio materials, in which the presence of free (unbound) nanoparticles is minimized.

In Ukraine, measures are being taken to expand research in the field of nanoscience. Thus, in 2010-2014, the State Targeted Nanotechnology and Nanotechnology Program operated with the main objective of recognizing the strategic importance of the development and implementation of nanotechnologies and nanomaterials at the state level, overcoming the country's backlog in the implementation of science and technology, methodological support for research coordination, development, formation and development of a technology base. One of the important tasks of this program is to study the potential risks of harmful effects of nanotechnologies and nanomaterials on humans and the environment. In view of this, nowadays the institutions of the National Academy of Sciences of Ukraine, NAAN, NAMS, as well as the Ministry of Education and Science of Ukraine synthesize nanoparticles, conduct research to determine their positive and negative effects on the body.

In the National Academy of Agrarian Sciences of Ukraine, a program of scientific research "Creation and use of nano- and biotechnological materials and means in animal husbandry" (the main institution - Institute of Animal Biology (IBT) of NAAS) was formed in 2016-2020. Completing the objectives of this program will ensure the development of nanobiotechnological materials and tools, studying their biological effects and effective use in livestock and veterinary medicine. The main goal of the established program is to provide the livestock industries of Ukraine with the latest effective and competitive nanotechnology developments, as well as specialized training of highly skilled personnel.

Nowadays, in IBT, research is carried out on such basic directions: creation of bioactive feed additives on the basis of nanocomponents; construction of carriers and vaccine adjuvants; creation of nanobiotechnological methods for the diagnosis of animal diseases; Investigation of the influence of nanoparticles in the biotechnology of reproduction of animals.

As for the creation of bioactive feed supplements on the basis of nanocomponents, nanocomposites in the form of nanocarboxylic acids, in particular citrates with high biological activity and non-toxic ones, are promising nanoproducts [6]. From this direction, during 2008-2015, I conducted comprehensive research on the physiological and biochemical mechanisms of the action of nanocarcinates of essential micro-elements in the organism of farm animals in different periods of ontogenetic development and productive use [1-5, 8 - 10, 13]. On the basis of a comparative study of the introduction of different amounts of nanocaccurate trace elements (Se, Cr, Co, Zn, Fe) into animal diets, minimum physiologically active and optimal doses for cattle, pigs, and rabbits were established. The influence of these compounds on the formation of immunobiological reactivity in an organism is investigated. contents in tissues and fluids of macro- and microelements; the state of antioxidant, detoxification, reproductive and immune systems; on the growth and development of calves, piglets and rabbits, as well as their role in the treatment and prevention of microelementosis of animals. The influence of nanoacqualates on the biological value of livestock production on the parameters of the chemical composition of milk, meat, fatty acids, trace elements and proteins has been studied. The results of the research that provided the development of a methodology for studying the biological effects of nanoacqualates in the organism of animals, as well as their impact on the biological value and quality of livestock products were obtained. Certain differences in the effects of Se, Cr, Fe in the organism of animals have been identified in comparison to other compounds of these trace elements due to their increased physiological activity and absorption rate in the digestive tract.

The addition of Cr, Se, Co, and Zn citrates to the cows during the first month of lactation promotes the growth of detoxification function of the liver, improves the metabolism of Ca, P and vitamin E. Mineral supplement stimulates secretory activity of the mammary gland, increases the daily milk intake from cows on 3.3 to 7.8% [8].

The complex action of microelements citrates on metabolic processes in the piglet organism during the period of weaning from sows was investigated. According to the results of the research, the expressed influence of the trace elements' citrates in the concentration less than 10 times (Fe - 150 mg, Zn - 110, Mn - 110, Cu - 155, Co - 1 mg), in comparison with their inorganic salts, on metabolic parameters in the blood, in particular, the growth of the antioxidant enzymatic activity of erythrocytes, the content of total protein and hemoglobin, and the number of erythrocytes. It has been proved that under the conditions of the combined application of nanocytes Fe, Zn, Mn, Cu, Co in feeding pigs, the adaptive capacity of their organism during the period of weaning from sows increases due to the stimulation of the functional activity of the antioxidant system, resistance and increased resistance animals to diseases [4].

A comprehensive study was carried out on the effect of Fe citrate in the preparation of nanofarocyte (TU U 21.2-30995014-009: 2014), created in IB, on the ferrum and oxigen transport blood function and metabolic processes in the piglets organism. The effectiveness of using this drug for the prevention of alimentary ferment deficiency anemia has been established. It was found that the introduction of citrate Fe contributes to the increase of the number of erythrocytes and the concentration of hemoglobin in the blood, positively affects the ferment binding function of transferrin, stabilizes the blood proteins, the content of Fe, Cu, Co, Mn, vitamins A and E, products of peroxide - lipid profiles and indicators of antioxidant system (superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase, reduced glutathione) [1, 13].

The high metabolic efficiency of the activity of chromium citrate (Cr (III)) in the animal organism has been experimentally proved for the parameters of carbon-carbon, protein and lipid metabolism, activation of

antioxidant, NO-synthase, endocrine and immune systems [4, 10]. It has been established that the addition of citric acid to the diet of the tartar corrects the function of the adrenal glands, thyroid and pancreas.

In pregnant krolatomes and sows, the addition of citrate Cr (III) to the ration improves various metabolic pathways, in particular, stabilizes blood glucose, increases the amount of glycogen in the liver and skeletal muscle, increases hexocysin and lactate dehydrogenase activity erythrocytes, increases the content of total protein and reduces the levels of triacylglycerols and cholesterol in the blood of animals, normalizes the antioxidant system and indicators of peroxidation of lipids, as well as improves the state of immune defense of the organism. Metabolic effective amounts of citrate Cr, which are additionally administered to rabbits and pigs, can be used as recommended doses for the regulation of metabolic processes and the prevention of the inadequacy of Sr (III) in the body [4]. Studies have shown that nanoacids are biologically effective and safe for health and are authorized for use in food products, in particular beekeeping. Thus, for the use of Cr, Se, and Ge citrates for feeding bees, a decrease in the content of heavy metals (Cd, Pb) was observed both in the tissues of the whole body and in individual anatomical parts of bees. Positive changes in the dynamics of the contents of individual fractions of lipids, which contribute to the processes of metabolic accumulation of energy and plastic components of the trophic chain, have been shown and prove the expediency of using citrate supplements in feeding bees [5]. The developed technical conditions (TU У 10.9-30995014-011: 2014) allow to produce and add to the components of feeding bees, Cr, Ge, Se, in the amount of 0.5 mg / 1000 ml each of syrup, which provides an increase their viability, the increase in the content of the organism and the production of beekeeping of essential micronutrients, lipid and carbohydrate components [7].

Thanks to nanotechnologies, the range of use of animal treatments can be expanded. Medicines that were previously not available due to their pharmacological properties (eg, poor solubility), pharmacokinetics (too rapid release), pharmacodynamics (adverse side effects), or therapeutic response (lack of efficacy under specific conditions), can be used soon. Nanotechnologies provide opportunities to eliminate many of these shortcomings and solve the problems that arise when needed for traditional therapy.

In the short term, due to the application of nanotechnologies, it will be possible to: supply veterinary preparations and vaccines with increased bioavailability in the body; to control the targeted delivery of drugs - to increase the concentration of the drug in the places of defeat and to reduce - in healthy tissues; reduce toxicity for the whole organism and modify the pharmacokinetics that results in controlled release from the body.

Promising is the development of nanotechnologies that are used to prevent and treat animal diseases with the use of targeted nanolakes with minimal side effects on the body. The essence of these developments lies in the fact that the active substance is attached to the surface of the nanoparticles, and the circulatory system is purposefully carrying the nanoparticle into the affected organs. Nanoparticles can penetrate the vascular walls, which helps their extravasation and accumulation in target tissues. This phenomenon, known as "increased permeability and retention," promotes active and passive targeting of nanoparticles to specific sites.

The conducted studies indicate the effectiveness of the use of new polymeric carriers on the basis of dimethylaminoethyl meth-cruate (polyDMAEM) for the transport of antisense oligodeoxynucleotides (asODN) into mammalian cells. It has been established that POLIDMAEM at a concentration of less than 5 μg / ml does not exert a cytotoxic effect on the culture of embryonic fibroblast cells of the L1210 mice. The results of the study of the effect of polyDMAEM and its complexes on ASDNA on the expression level of the physiological prion (PrP) in L1210 cells showed a 70-90% decrease in the content of PrPs. Possibility of successful application of conjugates of asODN and carrier for practically complete inhibition of expression of the physiological prion in the spleen, small intestine and, most importantly, the brain of animals. Consequently, it is promising that nano compounds can overcome the blood-brain barrier and influence the pathological process in the brain [2, 3]. Achieving nanotechnology in developed vaccines involves the use of new nanoparticle-based adjuvants, which are secured with antigens derived from synthetic peptides and recombinant proteins. Such vaccines are more effective, have no side effects and are safe to use [12].

Studies carried out in the IB show that new polyester pseudoamino acid-based nano polymers are not harmful to the organism and can be used as adjuvants in the process of vaccine production.

The work aimed at the study of nanosensory devices (laboratory chips) is important for the diagnosis of animal diseases. By their help, it is possible to diagnose animal diseases very quickly. In particular, chips detect blood markers that indicate a pathological process or the development of infection in the body [11].

A new method for detecting cationic oligolectrolyte conjugates with oligodeoxynucleotides was developed, based on which the free diffusion of these substances in 0.8% of agarose gel was developed. The proposed method in the I-B method makes it possible to simplify and cheapen the choice of the best nose among various polymeric compounds, to visually identify the fact of complexation between the interacting substances, the result of which is the formation of the precipitating ring. The versatility of this methodological approach is confirmed by interaction with oligodeoxynucleotides of another cationic polymer of natural origin - chitosan. A comparative analysis of the results of the use of this approach with the data of the turbidimetry of oligodeoxynucleotide-polymer complexes and their electrophoresis indicates a series Advantages, including the possibility of simultaneous screening of a large number of polymeric carriers, the absence of the need for the use of expensive expensive devices and materials. For the solution of complex formation, there is sufficient nanomolar amounts of oligodeoxynucleotides, which is important for the improvement of laboratory methods of research [2].

The IBT researchers are studying the biotechnological aspects of the use of functionalized nanoparticles of the AG (AG). In particular, the technology for the synthesis of spherical water stable functional Ag nanostructures with hyaluronic acid, bovine serum albumin and polyvinylpyrrolidone at higher concentrations (60-90 μg / ml) was developed in comparison with the standard synthesis method, which provided the release of nanoparticles in Concentration of 30 μg / ml. An improved method for obtaining a functionalized Ag nanoparticle at a higher concentration ensures a reduction in the cost of synthesis technology and reduces the time spent on it, which is a prerequisite for their further commercialization [9].

The use of Ag nanoparticles with hyaluronic acid has been grounded in order to determine the concentration of proteins and developed a fast, sensitive and relatively inexpensive method based on this technology. The obtained data on the use of Ag nanoparticles with hyaluronic acid to determine the concentration of proteins is a scientific basis for the development of laboratory diagnostic methods in modern analytical studies [9].

Complex studies have been carried out on the effects of the use of functionalized Ag nanoparticles in reproductive biotechnology, in particular oocyte maturation, sperm storage and embryo development in vitro, as well as in vivo fertilization and early embryonic development of rabbits. The obtained data are of great importance for the production of pharmaceutical preparations based on Ag nanoparticles and their subsequent use in the treatment of infectious diseases, in particular those associated with the reproductive system.

Consequently, nanotechnology is one of the most important areas in agrarian science. Due to their novelty and urgency, they bring Ukrainian science to the world level and in the future they can become decisive for the economic growth of our country.

Conclusions

The development of the Ukrainian agrarian sector should be based on the implementation of the latest developments of domestic scientists on nanotechnologies in livestock and veterinary medicine. The main problem to be solved is the recognition of the strategic significance of the development and implementation of nanotechnologies and nanomaterials at the state level, the scientific and methodological support for the coordination of research, the formation and development of a technological base, the satisfaction of the need for appropriate skilled personnel . Prospects for research in the field of nanotechnology and the creation of the nanosecond industry depend on the organization of the production of innovative competitive products on the basis of the introduction of nanotechnologies and state support, which will ensure the country's inevitable exit from the economic crisis and promote its development.

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