DEZINVASION EFFICIENCY OF COLLOIDAL SOLUTIONS OF METAL NANOPARTICLES AGAINST HELMINTH'S EGGS

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The perspectives of livestock industry functioning depends on many factors, including the quality and usefulness of feed, breeding formulation, raising and management conditions, animal welfare. Herewith a special place takes effective functioning of an antiparasitic measures system (**Adamen,** 2007, **Borysevich et al,** 2009, **Koval,** 2005, **Cherepanov et al,** 2003). Strategy for prevention of animals' helminthiasis should be based on a set of measures aimed at efficient destruction of pathogens at different stages of their development. In deworming, one of the most effective methods of prevention are desinvasion. A main problem in the fight against invasive disease is high viability of pathogens, the ability of helminth eggs and larvae survive after exposure to chemical disinfectants at concentrations and exposure, destructive for pathogenic microorganisms. As a result of the high stability of helminth eggs and larvae to natural factors the accumulation of invasive material in the environment takes place, as well as their long-term storage and creating the risk of contamination of animals and humans (**Voloshina et al.,** 2008). Creating of a product with active agent and an effective delivery system that would have large antiparasitic effect on worms and will reduce to a minimum negative impact on animals and people is of essential theoretical and practical importance (**Adamen,** 2007, **Burmystrov,** 2007, **Voloshina et al,** 2008, **Voloshina, Gorgol,** 2008, **Borysevich et al,** 2009, **Cherepanov et al.,** 2003.). In the realization of helminthes' eggs and larvae elimination effect promising is the use of nanomaterials, including nanometals (**Voloshina, Gorgol,** 2008). The most promising nanotechnology products are biocidal metal nanoparticles (Ag, Cu, Mg, Zn). Unique physical, chemical and biological properties of the biocidal metal nanoparticles (Ag, Cu, Mg, Zn) open up wide prospects of their use for diagnosis and treatment of diseases of animals. However, therapeutic and diagnostic applications of nanoparticles is often hampered by lack of information about their mechanism of action on animals and humans at the cellular and molecular levels. Stating of the value of natural systems and nanostructured nanomechanism in physiological, biochemical, immunological and genetic processes in the body requires a deep understanding of natural laws of functioning of living systems (**Burmystrov,** 2007, **Voloshina et al,** 2008, **Koval,** 2005, **Cherepanov et al,** 2003, **Cherepanov et al,** 2002, **Gerwert et al,** 2004).

MATERIAL AND METHODS

The study was performed on a pig farm "Velykosnitynske" and at Laboratory of Parasitology and Tropical Veterinary Medicine Department of the National University of Life and Environmental Sciences of Ukraine. The purpose of our study was to determine the effectiveness of desinvasion effect of colloidal solutions of nanoparticles of metals. Firstly found the level of contamination of the environment with helminth eggs. To do that, the scrapings were taken from the animals, feeders, drinking bowls, floor and stall walls, metal grids. Taken samples were investigated due to **A. I. Korchagin** (1986) and Fyulleborn methodology in the modification of **W. Tracz** (1992), followed by microscopy. For the determination of desinvasion effectiveness of colloidal solutions of nanoparticles of metals there were formed three experimental and one control groups of animals with 10 animals each. Animals were kept by group method in stalls of 20 m^2 each. The first stall was treated with anion-like magnesium nanoakvachelate. Second – with nanocomposite "Shumerian silver" with biocide properties of nanomaterials based on mutual application of nanoparticles of silver and copper as silver-copper nanoahlomerates, resulted in erosion-explosive method due to "Nanomaterials and Nanotechnology" Ltd technology. A new nanomaterial has a wide antibacterial, antiviral and antifungal spectrum of activity (neutralizes over 1,000 species of bacteria, viruses, fungi). Its efficiency is achieved through its unique set of properties of a composite "silver + copper" in nanoscale form. Small size (2-10x10-9 nm) silver nanoparticles have very large specific surface area (1000 m^2 / g or more), which

increases the contact area of silver with bacteria and viruses, and significantly improves, thus, its antibacterial properties. Besides this, silver nanoparticles compared to their ions are less toxic (**Burmystrov,** 2007). The presence of copper in the colloidal solution "Shumerian silver" increases the antibacterial properties of silver and enhances antiviral and antifungal spectrum of action (**Voloshina et al,** 2008, **Voloshina, Gorgol,** 2008). Third stall was treated with anionsimilar polymetallic agglomerates of nanoparticles Ag, Cu, Mg, Zn. The concentration of nanoparticles in colloidal solutions was about 100 dm^3. The control stall was watered with water. Before dezinvasion one made mechanical cleaning of each stall. The treatment was carried out in the presence of animals by using spray irrigation. Calculation of the working solution was 1 dm^3 for 1 m^2 stall. In 7 days after treatment carried out sampling for the sanitary and parasitological monitoring of the effectiveness of dezinvasion was made. After treatment constant clinical observation for the animals in these stalls were set.

RESULTS AND DISCUSSION

According to the held parasitological study we've found that all of the objects investigated, in different degrees, were contaminated with the eggs of parasites. In samples taken from the floor, there were found eggs of *Ascaris suum* in average 0.4 ind./G (in 1 g of tested material), *Oesophagostomum dentatum* – 1.1 ind./G. In samples selected from the surface of the walls, it was found *Trichuris suis* – 1.3 ind./G and larvae of *Strongylidae* type – 1.8 ind./G. In feeders and surface of drinking bowls there were found only larvae of *Oesophagostomum* in average 1.3 ind./G and 0.9 ind./G, respectively. At the skin of animals there were found eggs of *Oesophagostomum* and *Trichuris* with nematode embryos 0.8 ind./G and 1.2 ind./G in average. In 7 days after treatment carried out sampling for sanitary and parasitological monitoring of the effectiveness of dezinvation – at the scrapings we have found rare eggs of different species of nematode (roundworms (ascarosis), oesophagostomosis, trichurosis), all of which were unviable. Visually we've noted a change in their color, with distinct destructive changes within the eggs. Plasma inside the eggs became dark, and some nematode embryos had significantly shrinkage blastomeres. It should be noted that no helminth larvae were found. This indicates eggs elimination effect of nanoparticles of metals and stopping of eggs' development before the larval stage. In the control stall objects were contaminated with eggs and larvae Oesophagostomum and eggs Trichuris. The mostly contaminated with invasive elements was floor. Eggs and larvae of worms were viable. During the whole period of studies there were found with clinical observation no deviations from the animals' physiological norm. We assume that the mechanism of action of eggs elimination effect of biocidal metal nanoparticles (Ag, Cu, Mg, Zn) is linked with the effect of selective adhesion of metal nanoparticles to the surface of live eggs of worms and with the influence of a powerful electric field, formed by charged nanoparticles. All investigated nanocomposite metals showed 100% dezinvation effect. Electrically charged metal nanoparticles create conditions for continuous disinfection of viable parasitic elements excreted by diseased animals. This property of nanosubstance facilitates to profitability by saving of dezinvation solutions. Taking into account the maximum permissible concentrations of metals in the environment, the most environmentally friend is use of nanomagnesium because its maximum permissible concentration (MPC) is highest compared to other nanoparticles. Eggs elimination biocidal properties of the metals tested and validated in laboratory and industrial conditions and can be recommended for dezinvation of livestock buildings. Important from a practical point of view is that the metal nanoparticles besides the stated dezinvation properties has broad spectrum of biocidal properties against pathogens (*bacterias: such as Escherichia coli, Streptococcus, Staphylococcus, Bacillus blue purulent; viruses and mold)*. In general, it should be noted that the results widen the promising directions for further study of properties of metal nanoparticles and methods for their implementation in the diagnosis and prevention of parasitic diseases in particular. Eggs elimination mechanism of nanoparticles lays in the effect of "selective sedimentation" of anion similar nanoakvachelate metals to the surface of egg shell of only viable parasites and in the action of the electric field nanoelements. The advantages of the proposed product of dezinvasion at the base of nanoparticles is their environmental safety, the ability to interact only with viable parasite embryos and save eggs elimination properties with repeated use.

CONCLUSION

Biocidal metal nanoparticles at a concentration of 100 mg/dm^3 have highly expressed dezinvasion effect against viable pathogens of parasitic diseases of pigs. In particular, colloid nanoparticles of magnesium is the most environmentally friendly ones compared to other metal nanocomposite that allows extensive use of it in livestock buildings.

In the environmental objects of the researched groups after conducted dezinvation there were not found viable eggs and larvae of nematodes. All investigated nanocomposite metals showed 100 % dezinvasion effect regardless of the stage of embryonic development of parasite embryos. Electrically charged metal nanoparticles create conditions for continuous disinfection of viable parasitic elements that are excreted by diseased animals.

Due to nanostructure availability in biological materials the principle of natural high-energy is realized that requires further research.

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SUMMARY

In this article it is shown the results of experimental studies on the influence of metal nanoparticles of biocidal agents for animals' parasitic diseases curing. Proved that the biocidal metal nanoparticles in concentration of 100 mg/dm^3 showed an obvious desinvasion effect against viable pathogens of pigs' parasitic diseases. In particular, colloid nanoparticles of magnesium are the most environmentally friendly ones compared to other metal nanocompositions that allow to implement extensive use of them in livestock breeding. The results of experimental studies confirmed the promising application of metal nanoparticles in measures of livestock desinvation. Treatment with colloid metal nanoparticles can be used as a preventive measure for disinfection of livestock buildings and as a way of disinfection in areas of intensive accumulation of parasite eggs. The studies demonstrated the range of possible application areas of metal nanoparticles in diagnosis and prevention of invasive diseases, which is of practical importance for the control of parasitic situation. The results of our research and data from other authors stated that biocidal metal nanoparticles at a concentration of 100 mg/dm^3 have desinvation properties.

Key words: *desinvasion, helminthes' eggs, metal nanoparticles, nanoparticle of silver*
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