

Dynamics of the content of oxidative stress markers in boars during correction of reproductive ability reduction using gadolinium orthovanadate nanoparticles

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The leading link in the pathogenesis of reduced reproductive ability (RA) of males is the intensification of lipoperoxidation (LPO), the damaging effect of increased concentrations of stable metabolites of the Nitric oxide cycle, i.e. oxidative stress (OS) (Doshi et al., 2012; Pilane et al.; Koshevoy, Naumenko, 2020). Currently, there are few effective means of OS correction, and their development is of considerable interest to researchers. Nanomaterials are of particular note, in particular nanoparticles (NPs) of rare earth metals with pronounced redox activity (Averchenko et al., 2015). The positive effect of NPs gadolinium orthovanadate on the reproductive system of male rats has been proven (Karpenko et al., 2018).

The aim of the research was to analyze the dynamics of the content of oxidative stress markers in boars during the correction of low reproductive ability using gadolinium orthovanadate nanoparticles.

The experiments were carried out on boars of Vlada rural farm of Yuryivsky district, Dnipropetrovsk region. Two groups with 5 animals in each were formed: control one — animals with normal sperm quality and experimental one — animals with ejaculates characterized by low quality of motility and the number of motile sperm. To correct the reduction of RA, males of the experimental group were orally administered hydrosol of NPs gadolinium orthovanadate activated by europium size 25×8 nm in granular form at a dose of 0.0125 mg per kg live weight for 14 days. The NPs were synthesized by the Department of Nanostructured Materials of the Institute of Scintillation Materials of the NAS of Ukraine and obtained for research under the agreement on scientific and practical cooperation. The material for the study were blood serum samples, which were taken on the 1st, 15th and 30th day by conventional methods. Spectrophotometric methods were used to determine the concentrations of diene conjugates (DC) (Stalnaya & Garnishvili, 1977), malonic dialdehyde (MDA) (Fedorova, Korshunova & LarSKIY, 1983) and stable metabolites of Nitric oxide cycle (NO_x) (Golikov, 2004). Statistical processing of the results by Student's *t*-test was carried out.

Analyzing the results of biochemical studies, the presence of OS in males of the experimental group was established: the content of primary products of LPO — DC was reliably higher than the control indicators by 19.3% ($P < 0.01$). There was also a 1.07-fold increase in MDA concentration ($P < 0.001$) in blood serum. The amount of NO_x was also significantly increased by 83.6% ($P < 0.001$).

During the correction using gadolinium orthovanadate there was revealed that the studied parameters had a positive dynamics of changes on the 15th day of the study — the amount of DC tended to decrease and was 5.4% less than parameters in the animals before the introduction of NPs, while the concentration of MDA was reliably lower by 24.7% ($P < 0.05$). The amount of NO_x also decreased by 25.2% ($P < 0.001$). On the 30th day of the study, the restoration of prooxidant balance was observed in the blood serum, which almost reached the values of the control group of animals. The DC content was reliably reduced by 9.4% ($P < 0.05$), the concentration of MDA was 48.2% ($P < 0.001$) lower than the parameters in the group before the administration. This indicates a decrease in the intensity of LPO processes and the presence of a prolonged effect of the introduction of NP hydrosol. Similar changes were observed in the Nitric oxide cycle — its amount was lower by 42.6% ($P < 0.001$).

The administration of the hydrosol of gadolinium orthovanadate nanoparticles showed a positive dynamics of changes in the intensity of peroxidation processes, as evidenced by a decrease in the number of diene conjugates in blood serum, normalization of oxidative processes in males was confirmed by a reliable decrease in malonic dialdehyde. It is established that the activity of stable metabolites of the Nitric oxide cycle decreases, which indicates the normalization of the reproductive potential of males. The obtained data allow us to conclude about the effectiveness of the use of gadolinium orthovanadate nanoparticles to correct the decrease in the reproductive ability of boars under oxidative stress.