



Complex hormonal-vitamin nanosomal preparations of argentum, zinc and copper nanoparticles for effective treatment of cows' endometritis

I. Gevkan¹, V. Syrvatka^{1,2}, O. Shtapenko¹

¹ Institute of Animal Biology NAAS, Laboratory of Reproductive Biotechnology, Lviv, Ukraine

² Ivan Franko National University of Lviv, Genetic and Biotechnology department, Lviv, Ukraine

Introduction

Our work aimed to establish the effect of nanoparticles on biological processes for their effective use in reproductive biotechnology. We established the optimal doses of zinc and copper nanoparticles on reproductive cells. The effect of silver, zinc, and copper nanoparticles on the healing of burn wounds in rats was established. The data of the influence of intraperitoneal injections of zinc and copper nanoparticles on metabolic processes and reproductive capacity of rabbits and the toxicological effect of intravaginal administration of silver nanoparticles in rabbits were obtained.

Material & Methods

We obtained argentum, zinc, and copper nanoparticles with chitosan that have strong bactericidal properties by an improved method [Xiong et. etc. 2011; Sheehan and others. Etc. 2014]. To study the bactericidal action of nanosomal emulsions, firstly bacteria at a concentration of 10^6 - 10^5 colony-forming units (CFU) were cultivated during 24 h in 96-well plates in 200 μ l of nutrient broth at 36°C under adding different concentrations of Ag, Cu and Zn nanoparticles and their nanosomal emulsions diluted with deionized water. Then, 20 μ l of culture medium was taken from each well and cultivated in a thermostat in Petri dishes with solid nutrient medium during 24 h and the number of bacterial colonies that remained viable after exposure to the drugs was counted. The activity of blood enzymes - AST, ALT, ALP, creatinine, cholesterol, triglycerides, calcium and phosphorus, total protein and albumin, and urea level was determined using test systems on a biochemical analyzer. Determination of blood hematological parameters: number of erythrocytes in 1 cm³, hemoglobin content, hematocrit, average erythrocyte volume, number of platelets and leukocytes and leukoformula was performed on a hematology analyzer.

Results

The main result of our study is the creation of effective complex hormonal-vitamin nano-preparations for the treatment of cows' purulent endometritis. Argentum, zinc and copper nanoparticles at a concentration of 0.1 μ g/ml showed bactericidal properties to the strains: *Bacillus subtilis* ATCC 31324, *Pseudomonas aeruginosa* ATCC 9027, *Candida albicans* ATCC 885-653, *Escherichia coli* ATCC 25923, *Staphylococcus aureus* ATCC 25922 and *Klebsiella pneumoniae* ATCC 2579. Argentum nanoparticles with chitosan had better antibacterial properties than nanoparticles with polyvinylpyrrolidone and copper nanoparticles were better than zinc nanoparticles. Nanosomal emulsions of nanoparticles have slightly reduced bactericidal properties compared to native nanoparticles due to the smaller contact area of particles with microorganisms. However, the concentration of nanoparticles in nanosomal preparations can successfully inactivate most pathogenic microorganisms in the uterus of cows.

The created complex hormonal-vitamin nano-preparations were tested on cows with endometritis in private farm LLC "Barkom" in Pustomyty district of Lviv region. We used current standard antibiotic schemes of treatment as the control. Biochemical and hematological parameters in the dynamics of endometritis treatment were used as indicators of nanomaterials' toxic effects on the cows' bodies. We obtained great efficacy of nano-preparations in the treatment of cows' endometritis. Furthermore, complex hormonal-vitamin nano-preparations lead to effective correction of the reproductive function of animals at the pathology and have a positive effect on reproductive processes repair in comparison with the control (antibiotic treatment).

Therefore, complex hormonal-vitamin nanosomal preparations of argentum, zinc and copper nanoparticles have high efficacy in the treatment of purulent-catarrhal cows' endometritis.

Table 1. Minimum bactericidal concentration of nanoparticles of Argentum, Cuprum and Zinc

	Minimum bactericidal concentration, μ g / ml							
	AgNPs-Chit		AgNPs-Starch		CuNPs-Chit		ZnNPs-Chit	
	Free NPs	Nanosomal form	Free NPs	Nanosomal form	Free NPs	Nanosomal form	Free NPs	Nanosomal form
<i>B. subtilis</i>	0,011	0,053	0,026	0,053	0,0117	0,0295	0,027	0,0405
<i>P. aeruginosa</i>	0,026	0,053	0,12	0,12	0,2950	0,30	0,0675	0,081
<i>C. albicans</i>	0,009	0,012	0,03	0,039	0,052	0,052	0,3	0,59
<i>E. coli</i>	0,009	0,012	0,0225	0,03	0,0117	0,0295	0,081	0,101
<i>K. pneumoniae</i>	0,006	0,012	0,03	0,039	0,0295	0,030	0,135	0,145
<i>S. aureus</i>	0,012	0,02	0,026	0,053	0,0295	0,030	0,3	0,59

Table 2. The effectiveness of the drug "Nano-3-chitosan" and in comparison with the control with the emulsion of the drug "Metricur"

Group of animals	Number of animals in the group	The duration of the period of use of drugs	Recovered after treatment		Cows fertilized after treatment	Number of days of infertility		Duration from childbirth to fertilization
			Goal.	%		In the group	On 1 goal.	
Control	22	6 дiб	15	68,2	15	1590	106	136
Experimental	30	6 дiб	28	93,3	28	1576	92	122

Conclusions

The high efficiency and lack of toxic effects make nanosomal preparations promising alternatives agents to antibiotics for the treatment of animal infectious diseases.