ANALYSIS OF ENERGY STATE OF A DISCRETE FRACTIONALLY ONE- AND TWO -LAYER OSCILLATORY SPHERICAL NET MODEL OF MOUSE *ZONA PELUCIDA*

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ABSTRACT

As there are experimental evidences that Zona Pelucida (ZP) changes its elasticity during process of maturation we may supposed that ZP changes its oscillatory states as well. One of biological functions of this multi-layer mesh-like 3D structure that surrounds mammalian oocytes is selectivity regarding sperm penetration. On a basis of single-layered oscillatory spherical net model of mouse ZP (mZP) the improved double layer model is developed. Two new variables were included into the model: double-layered network and visco-elastic properties between its constructive elements. Due to visco-elastic properties of ZP and its importance for mechanism of sperm penetration double layered oscillatory net model of mZP has fractional order properties. Molecules in double-layered oscillatory mZP model are interconnected with standard light fractional order visco-elastic element defined by constitutive relation force - elongation expressed by fractional order derivatives.

Oscillatory behavior of this double-layered system is discussed. As the sperm has to penetrate ZP it is of great importance what is the energy barrier it has to pass or what is the energy it has to own to fulfill the demands of ZP selection criteria. The energy states of one and double layered ZP oscillatory fractional order model of mZP are analyzed.

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