Native nanoobjects and technology of capsulation increasing their stability to environment unfavorable factors.

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Introduction

All means of the scientific information distribution are filled by the most interesting results received in various scientific canters and executed on the equipment, allowing open the mechanisms of living systems functioning in new sharply varying conditions of world around.
Powerful base for the analysis of the developed situation and the forecast of the further development of living systems in conditions of risks, stressful situations and adaptations to real existence conditions are nano – and information technologies extended and explained as in theoretical and practical aspects. These modern directions in a science, in particular biology, will serve as a base to formation of new paradigms, following which, probably, it will be possible to develop mechanisms of «adoption» of biological systems to varying conditions of an environment.

Results and Discussions

In a series, for our opinion, interesting works it has theoretically and experimentally been shown, that under the influence of external factors on living systems the density and viscosity of protoplasm of cells changed [Razmaev I.I., 1976, Rashidova S.Sh.et.al.,1996]. Also it has been established, that the inhibition of water intake in the seeds covered by polymeric systems led to changes of a direction and speed of life-support processes that in result promoted accumulation of intermediate products of a metabolism [Ruban I.N.et.al.,1995]. In authors' opinion, it is connected to the low content of colloidal-bounded water insufficient to reduce the speed of metabolic processes, when water intake in living systems (on an example of a seed) is inhibited. As a result hydrolysis rates of reserve substances in seeds were higher, than rates of inclusion of hydrolysis products in biosynthesis and formation of substances de novo. Such interpretation of experimental materials became possible owing to the postulated role of the water bounded on a surface of cell protoplast biopolymers (colloidal-bounded water) as an element of fine regulatory mechanism of targeting and rate of processes of life-support in living systems [Ruban I.N., 2004, Ruban I.N., 2002]. Authors of this researches are connected the established facts with reaction of living organisms to stress, without going deeply into the root of the processes, which can occur in a cell in connection with increase in density, viscosity of protoplasm, and also accumulation of intermediate metabolic products [Rashidova S.Sh.et.al.,1996, Ruban I.N.et.al.,1995, Ruban I.N., 2004, Ruban I.N., 2002]. At change of such important physical and chemical parameters of solutions towards their increases the starting of water structuring process right up to its crystallization in a cell is possible.
At water crystallization caused by various stressful factors (water deficit caused by seeds capsulation, low temperatures, infringement of a salt exchange, etc.), keeping of the primary information in its crystals can take place (water in various modular conditions possesses with memory), that is necessary for life-support of the cell. Information is released after removal of adverse environmental conditions and is perceived by molecules of water in the structured condition, forming the information fields. Besides a rapprochement of metabolites molecules making a basis of protoplasm occur at increasing of the density and viscosity of cell protoplasm. Not excepting, that the accumulated intermediate metabolic products can serve as "centers" of cluster formation from intermediate metabolic products in case of water deficiency. The mechanism of gel formation is determined by mole-

cules rapprochement to each other so that formation of intermolecular bound and hooks is possible. It promotes gel formation in nonequilibrium conditions [Holmuminov A.A. et.al , 2001]. Gel formation process leads to regulating of the system, therefore the rates of life-support processes decrease and create new conditions for functioning of a cell and living system at whole. All these structures possess with their own information field, which are intersect at rapprochement and form certain «zone of covering», that create associates possessing by own information field, which is distinct from fields of metabolite molecules. «Zones of covering» can introduce a new information, which is distinct from that information kept in crystals of water, and to form virtual fields, in which «clots of the information» arising from the information fields of the molecules included to cluster are formed. This new (unidentified) information provides the reorganization of a metabolism in reply to stressful factors and defines the moment of adaptation of living systems to adverse environmental factors. Here, in our opinion, rather remote analogies to processes of formation of new structures- nanoparticles in interphase area are quite appropriate [Nesterov A.E., Lipatov Yu.S. ,1984, Lipatov Yu. S., 1997, Voropaeva N.L.,2003].

There is an original "hybridization" of information fields in «zones of information covering», at which new structures (metabolites - fibers, enzymes, etc.) possessing with other physical and chemical parameters and biological properties may appear [Shadmanov R.K., Saranskaya L.B., 2003, Shadmanov R.K. et.al.,2003.]. They define in particular the moment of adaptation. After removal of stress (in our case that is the dissolution of capsules on a surface of seeds) the information fields of these structures are kept and define the orientation of microevolutionary processes, enabling occurrence of new adaptive biotypes in populations of living organisms.

Probably, it is not the unique mechanism of formation of new functional structures. Other mechanism can lies in the following paradigm. In «a zone of covering» of information fields of metabolites and macromolecules as a result of alteration of viscosity and density of the protoplasm provided by the altered environmental factors, both metabolites and such structures as RNA also may alter. For example, mRNA as being situated in the changed cytoplasm medium passes into other conformation due to its three-dimensional organization [Spirin A.S.,2001]. It leads to releasing of new sites of mRNA for translation of and synthesis of proteins with altered properties providing a homeostasis in new environmental conditions.

The modification of nitrogen bases leading to appearance of mRNA triplets absent in the sequence of matrix DNA occurs in «zones of covering» due to their "hybrid" nature. It will be accompanied also by the synthesis of new proteins which were absent before stresses. The opportunity of such way as one of regulatory mechanisms of compensatory-adaptive reaction of organisms under influence of environmental conditions is presented in [Gvozdev V.A,1996]. What can be the general mechanism of formation of new structures, including macromolecular structures? For formation of conception about the general mechanism we shall examine the living systems from the point of view of microscopic (atomic), mesoscopic (molecular, nano-) and supramolecular levels (hierarchies) of their organization, giving special consideration to two last hierarchical levels.

The modern ecological situation is characterized by formation of numerous stressful factors which influence to living systems. For creation of adaptive living systems it is appropriate to assume, that clusters consisting of molecule associates providing adaptation to individual of stresses are formed and function in the cells. These nanosize structures are formed on mesoscopic level and have various quantities of allowed conformations due to their sizes and structures. At that it depends of clusters formation medium кластеров which alters in our case depending from environmental factors (density, viscosity of cell protoplasm, quantity of accumulated metabolites and their chemical structure). The quantity of allowed conformations is connected to quantity of quasi-chemical reactions which are occuring in real conditions of cell functioning, formation of intermediate products and biosynthesis of cellular structures. The variety of negative factors of influenced on living systems can lead to formation of uniform cluster, which will define whole system of adaptation of an living organism to all variety of negative factors. Besides it is necessary to take into consideration, that complex structures may exist in complex environment (cell protoplasm) [Malinetskiy G, 2000]. And, finally, from the point of view of modern paradigms, the existence of uniform cluster is more

thermodynamically favorable, than presence of many clusters in the system that is the main thing in cluster formation process. “Solution-gel” transition is analyzed applying the Ising’s lattice model [Klenin V.I.,1995] based on percolation (passing on bonds and points of clusters). The structural element is placed in each unit of Ising’s lattice with probability P_b. There is a communication between the near elements which united the clusters of average size, increase with P_b increasing. Infinite cluster which refers to as a threshold of passing is formed at some $P_{b.cr}$ value. Near to a threshold of passing the size of cluster is estimated on equality:

$G=Go\ \{P_b-P_{b.cr.}\}^{-\gamma}$ (1)

where γ is a critical parameter of correlation of cluster length. Formation of number of bonding points can be considered as $Q=Qo\ \{P_b-P_{b}.cr\}^{-\beta}$ (2)

where β is critical parameter of order. The following equalities are pertinent for formation of points:

$G=Go\ \{X_b-X_{b.cr.}\}^{-\gamma}$ (3)

$Q=Qo\ \{X_b-X_{b.cr}\}-\beta$ (4)

where X is concentration of cluster points.

For an average field $\beta=1$ and $\gamma=0.25$. The critical size characterizes the beginning of formation infinite cluster that corresponds to the beginning of gel formation.

On the basis of experimental data the calculations on the equations (1-4) have been made and dependence of probability of P_p percolation from bonds P_b, describing dynamics of “solution-gel” transition of fibroin more generally [Holmuminov A.A. et.al , 2001] is revealed.

It is necessary to note, that many physiological processes underlying in adaptation of living systems to different stresses, for example, such as drought and salinity, are close each to other [Harborn J.,1985], that allows to assume the existence of the uniform mechanism of metabolites’ cluster formation, which information field, having formed from information fields of separate clusters, is the defining factor in reorganization of living systems during influence of stress, after its removal and adaptation to varying factors of an environment.

Mechanisms of cluster formation in cells of living organisms are not clear yet, and consequently we carry out search of analogies of cluster formation in the living and nonliving nature [Ruban I.N, 2002]. At that known mechanisms of cluster formation with application of Witten–Sandler algorithm and its modifications describing the synthesis of the branched polymers (dendrimers) in case when dendrimer growth is limited only by content of monomers in reaction system [Ivanova E.K et.al., 2006, Rashidova S.Sh. et.al. 2005, Sidorenko O.E et.al. 2004], whereas in biological systems the cluster growth can be limited by quantity of stressful factors on living systems. Deeper analogies between cluster formation and formation of information fields in the living and nonliving nature consisting in formation of micro- and mesoscopic (nano) structures with expressed nanoproperties can appear [Ruban I.N. et.al.,2004]. Nanoproperties of such clusters means biological features of the generated new biotypes appear as a result of adaptation to external environmental factors in microevolutionary processes (biological systems), or specific characteristics of the substances obtained on the basis of dendrimers (polymeric systems).

References

1. Razmaev I.I. (1976). *About density of colloid-bounded water in vivo*. WASCNIL Reports. **38.** p.23-24.
2. Rashidova S.Sh et al. (1996.) *Biologically active agricultural polymers. (Mechanism of action on plants).* Polymeric Materials Encyclopedia (USA), **1.** p.615-628.
3. Ruban I.N. et.al. (1995.) *Nature of the oscillations in complex molecular systems in non-equilibrium state.*. Biophysics..40**. 3.** p. 14-15.
4. I.N.Ruban. (2004). *Theory and practice of seed covering by polymers.* In the book of abstracts MACRO 2004. P4.2-65. p.146.
5. Ruban I.N. et.al.(2002) *To the mechanism of polymeric covers on seeds (capsulation.) Biophysical aspects.* In the

book X international BRG workshop on bioencapsulation "Cell physiology and interactios of biomaterials and matrices". Prague. Czech Republik. p.45-49.
6. Holmuminov A.A. . et.al. (2001) .*Research of self-organizational processes in modelling of biopolymeric systems*. In: Collection of ICPP AS RUz . Tashkent. p.11-14.
7. Nesterov A.E., Lipatov Yu.S. (1984) *Thermodynamics of solutions and mixtures of polymers.* Kiev. Naukova Dumka. 300 p.
8. Lipatov Yu. S.(1997*). Thermodynamics of polymer blends*. London. 203 p.
9. Voropaeva N.L. (2003). *Water-soluble polymeric mixtures: obtaining, structure and properties*. Doctor thesis. 250 p.
10. Shadmanov R.K., Saranskaya L.B. (2003*). Realite and perspectives of biochemical technologies in revealing of cotton adaptive biotypes, improvement of cultivars and shortening of breeding process.* In: World Cotton Research Conference-3. Cape Town. South Africa
11. Shadmanov R.K. et.al.(2003). *Biochemical adaptation of plants to factors of an environment and its practical use.* In: the Collection of materials of International Scientific-practical conference « Problems of ecology in agriculture», Bukhara.
12. Spirin A.S.(2001*). Biosynthesis of proteins, world of RNA and an origin of the life.* J. Vestnik of the Russian Academy of Science. №4. p. 320-328.
13. Gvozdev V.A.(1996*). Regulation of activity of genes at maturing cellular RNA.* Soros Educational Journal. 12. p. 11-18.
14. Malinetskiy G. (2000). *Sinergetics and high technologies.* J. Sum of technologies, , №2, p.57-62.
15. Klenin V.I.(1995). *Termodinamics of systems with flexible-chain polymers*. Saratov. SarSU. p. 735.
16. Harborn J.(1985). *Introduction to ecological biochemistry*. M.535 p.
17. Ruban I.N. et.al.(2002). *Polimeric system with variable fractal dimension and corridors of transition "nonliving"↔"living"*. Abstract book of. Republican conference "Polymer-2002". Tashkent.p. 47-48.
18. Ivanova E.K. et.al. (2006).J. Material science. 7. p.7.
19. Rashidova S.Sh., . et.al. (2005*). Witten-Sandler modified algorithm for hyperbranched polymers formation modeling. In the book of European Polymer Congress*, Moscow, Russian .P.7.4-21. Ref 4433. p. 210.
20. Sidorenko O.E. et.al. (2004). *Modified Withen - Sandler algorithm for modeling the formation of polymer nanostructures.* In: Theoretical aspects of polymeric nanostructures formation. Tashkent. p.36.
21. Ruban I.N. et.al. (2004). *Theoretical description of creation, stabilization and functioning of nanostructures (one of possible way*). In: Theoretical aspects of polymeric nanostructures formation. Tashkent. 2004. p.15.