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Cluster Model of Formation of Protein Nanoparticles and Mesoobjects

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We consider a scheme of a direct synthesis of volumetric protein nanoparticles and Nanofibres without formation of polypeptide Nanochains in a system previously consisted of amino acid molecules and nucleic acid molecules (Citoplasma). Developed cluster model is based on asymptotic method of formation kinetics of objects having quantum features [1, 2].

A conception of distribution density wave in the space of cluster sizes a is used.

The wave travels with the time t toward an increase in the cluster size.

The following formula for the spatial factor of distribution density function has been deduced:

$$P \approx \left(\frac{a}{a_0}\right)^{-3/4} \cos(2\sqrt{2}\lambda/5\beta^{1/2})\left[\left(\frac{a}{a_0}\right)^{5/2} - 1\right].$$

Here, $\beta \approx ht_i/2m_0a_0^2, t_i$ is the time scale of a single act of objects interaction, 0, 0 a m are size and mass of germ – amino acid molecule, $\lambda = \sqrt{15/2}$

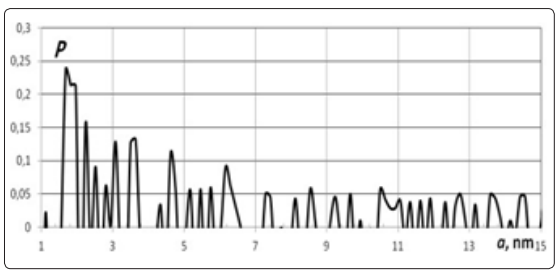

Figure 1: Calculated total spectrum of sizes of nanoparticles formed from glycine molecules (rotary interactions).

Figure 1 demonstrates the existence of discrete set of nanoparticles formed from germs.

Set of calculations for all amino acid germs (Glycine, Alanine, Valine, Tryptophan) allows one to single out the following typical neighborhood and "magic" sizes corresponding to proteins of Mioglobin, Insulin, Lisozyme, Hemoglobin, Albumin, Lipoprotein, Apoferritin, lurnazin mag = (1.4–1.7), (2.2–2.5), (2.7–2.9–3.3), (4–4.6– 4.7), (5–5.5–5.6), (6–6.7–7), (8–8.5), 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23 nm.

The following expression for the maximum object size has been deduced:

$$a_{\max} \cong \frac{2}{9}\frac{m_0}{h}\frac{a_0^3}{\Delta t_{\min}}$$

Here, mintΔ is a minimum time interval of an elementary act of object interaction determined by physical nature of the process (rotation or oscillation).

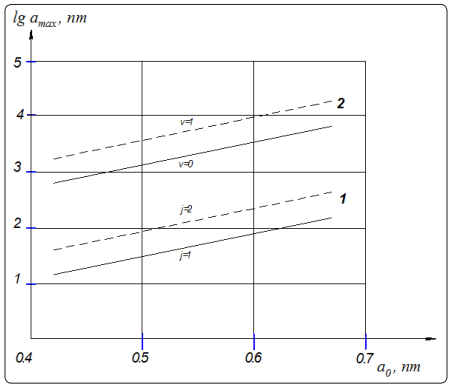

Figure 2: Calculated dependences of maximal sizes of biological nanoparticles and mesoobjects from germ sizes:

1 – Rotatory levels, j = 1 is basic state, j = 2 is first excited state; 2 – Oscillating levels, v = 0 is basic state, v = 1 is first excited state.

The maximum sizes of mesoobjects from above listed germs have been calculated by the above formula and provided the values 0.6; 1.1; 2.1 and 7 μm at basic state of oscillating quantum system. These values correspond to lysosomes, mitochondrions, red cells, thrombocytes, and small lymphocytes. More detailed calculations have been presented at Figure 2. The calculated results testify to the fact that at the "instant" excitation of a biological system, e.g., under absorption of the radiation energy of various nature, it is possible that nanoparticle and mesoobject significantly increase in

sizes. At plane geometry objects of square form with a side size a and a thickness z are considered. Following by theoretical method [1] one can deduce the following expressions for a probable thickness and for a dependence of side size in growth time t:

$$z \approx \frac{m_0 a_0^3}{2\hbar t_i}, \quad a \approx \sqrt{\frac{2\hbar t}{m_0}}.$$

Complete calculated diapason of mesoobjects thickness is equal to $Z \approx 0.008–75$ μm. One can suppose that such large range of thicknesses for hypothetical flat mesoobjects without DNA makes it possible to cause malignant areas in biological matter. One can obtain that, for example, formation time for mesoobject with the side size $a = 100$ μm amounts to $\tau \approx 10$ s for glycine molecules, and $\tau \approx 17$ s for tryptophan molecules independently from the thickness. Calculated time values are sufficiently large for observing the presumptive process of flat mesoobjects formation at laboratory experimental investigation – clinical research.

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