EPIGENETIC REGULATION IS PRIME ELEMENT IN THE CONTROL OVER STOCHASTIC GENE EXPRESSION

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Gene expression is the process stochastic (random) by its nature. As a result, there are significant variations in the levels of both mRNA and proteins among genetically identical cells which belong to the same population. Expression heterogeneity has been revealed across a wide range of organisms, from bacteria to mammalians. Its characteristics depend on genetic, epigenetic and biophysical parameters. Random fluctuations occurring during the use of genetic material (expression noise) play an important role in many biological processes, such as phenotype switching and coordination of gene expression during cell differentiation and cell cycle. Stochasticity of the gene expression may have crucial consequences both for a particular cell and for the cell population as a whole, being helpful in some contexts and harmful in others. Hence, some mechanisms ensuring resistance to the noise and control over it should have been developed in the course of the evolution. Over recent years there have been a growing number of experimental and theoretical studies which point to epigenetic regulation as the prime element in the control over stochastic heterogeneity of gene expression. In the review, we analyze main epigenetic mechanisms involved in the expression noise control. There are also particular examples of epigenetic regulation of stochastic gene expression in different organisms chosen in accordance with the increasing biological complexity: from viruses to mammalians. There is a separate chapter devoted to the functioning of the epigenetic system controlling expression variability of the genes during Metazoa development.

Keywords: epigenetic mechanisms, expression noise, regulation of stochastic processes, stochastic cellular heterogeneity