COMPUTER SIMULATION OF ORIGIN AND EVOLUTION OF SIGNALLING SYSTEMS

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Motivation and Aim: Origin of neuroendocrine systems in evolution relay on the signaling functions of molecules produced by specific cells and glands, and each of these molecules "codes" some conditions of internal milieu and environment for the cell and the whole organism[1]. The aim of the work was to create a simulation model which imitates origin of signaling systems that are capable of coordinating reproduction of a subject with its ability to perform successfully reproduction and to produce optimal number of offspring.

Methods and Algorithms: The control populations consist of objects that acquire some random amount of resources and produce genetically determined number of offspring (n) if their resources are larger than (R)x(n), (R – minimal resource of a viable descendent, each of which gets an equal part of the parental resource). Otherwise, if the object's resource is less than (R)x(n), it has now descendents. Total amount of the resource randomly distributed in each iteration (generation) among the objects remains constant.

Results: By varying the initial number the objects, genetic level of their fecundity, the flow of resource and inequality of its distribution among the objects, we have selected the parameters leading to extinction of the model control populations within 500-600 iterations and use these parameters in all subsequent experiments. Objects in experimental populations were allowed to obtain randomly two types of mutations "a" and "b" separately or both at a low probability level (0.001). The a-mutation imitates the signaling function of the thyroid hormone and confers to the carrier the ability to bypass one round of reproduction if it's resource is less than (R)x(n). Mutation "b" imitates effect of sex steroids and confers to the carrier the ability to produce variable number of offspring if this carrier has resources more then (R)x2. The number of b-mutant descendants is determined as integer of (b-mutant's resource)/R. Each a- or b-mutants totally replaced wild-type subjects in all populations in which these mutations were allowed within several tenth of iterations, and 1/3 and 1/2 of these populations respectively were still present by the end of experiments lasting 3000 iterations. Double a/b-mutants replaced all other genotypes from the populations within first hundreds of iterations. All populations of the a/b-mutants exist with a maximum number of objects in a generation as compared to populations of other genotypes throughout the whole experiment.

Conclusion: The use of "coding" molecules for adjusting the organism's reproduction to it's ability to perform this process successfully in accordance with conditions of internal milieu and environment may be under strong pressure of natural selection which evidently "creates" hormones and hormonal systems during early stapes of metazoan evolution.

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