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Editorial

Why did not Poikilothermic Animals become Homeothermic?

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Some animals maintain temperature homeostasis in the body due to external sources of energy (poikilothermy), others due to the energy of food consumption (homeothermy). Homeothermy ("warm bloodedness") is maintained endothermically, i.e., by-product of metabolic heat. In poikilothermic animals ("cold bloodiness"), in contrast to homeothermic animals, body temperature passively follows the change of the environment temperature. It is known that homeothermy takes place when living beings has a high level of cellular metabolism. However, the cause of this high metabolic rate remains a source of controversy [Ruben 1995; Boldrinia et al., 2018]. Why did not poikilothermic animals become homeothermic? Because poikilothermic animals are unable to maintain high levels of cellular metabolism, the main source of heat energy, in the body. The problem is not due to a lack of cellular metabolism in poikilothermic organisms. The reason is the relatively low physical density of the layer of condensed chromatin around the nucleus, which, because of its low thermal conductivity, is not able to dissipate heat energy well into the cytoplasm and thus efficiently eliminate the temperature difference between them (cell thermoregulation) [Ibraimov 2003; 2020a,b]. Homeothermic animals can constantly maintain a relatively high body temperature (36 ⁰C - 42 ⁰C) for an indefinitely long time, and this is not related to the perfection of their cellular metabolism. They owe this peculiarity to the layer of condensed chromatin, possessing, in comparison with poikilotherms, high physical density (respectively, high thermal conductivity), which is able to effectively remove excessive heat from the nucleus. By excessive heat, we mean the state when the heat level exceeds the permissible level for a given animal species to such an extent that the normal molecular activity of the nucleus is disturbed [Ibraimov 2003; 2022]. Why is efficient and timely dissipation of excess heat from the nucleus so important? Because for the production of products necessary for cellular metabolism (ribosomes, RNA etc.) and normal implementation of complex molecular-genetic processes (repair, recombination, rearrangement, modification, restriction, replication, transcription, packaging, organized movement) in the nucleus, it is necessary to maintain an optimal temperature level here. When the temperature increases in the nucleus, serious disturbances of these processes and their coordination as a whole occur, which can lead to severe consequences. In other words, the poikilotherms did not become homeotherms not because they are unable to produce much heat due to the imperfection of their cellular metabolism (metabolic heat production), but because their nuclei cease to function normally due to overheating, since excess heat is not dissipated from there efficiently [Ibraimov 2019; 2020b,c]. Why is the density of condensed chromatin layer around the nucleus lower in poikilothermic animals than in homeothermic animals? This circumstance is related to the peculiarities of chromosomal heterochromatin regions (HRs) in these organisms. The point is that the layer of condensed chromatin around the cell nucleus consists of chromosomal HRs (C- and Q-HRs) and chromosomal bands (C+, G+ and Q+ bands), which are very different in poikilothermic and homeothermic animals. In poikilothermic animals, with the exception of C-heterochromatin, chromosomal G+ and Q+ bands are either weakly expressed or absent. Whereas in homeothermic animals all chromosomal HRs and bands known to science are well manifested. And in the genome of humans and two other higher primates (chimpanzees and gorillas) besides C-heterochromatin there is also Q-heterochromatin, which corresponds to reality: humans have the most perfect thermoregulation system, then primates and other mammals [Ibraimov 2019; 2020c; 2022]. Thus, poikilothermic organisms did not become homeothermic not because their cellular metabolism is not perfect, but because they have not developed cell thermoregulation due to the low density of the layer of condensed chromatin around the nucleus not able to efficiently eliminate temperature differences between the nucleus and cytoplasm.

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