



SELF-REGULATION SYSTEMS OF INVERTEBRATES AND VERTEBRATES

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Annotation. *This article scientifically analyzes the structure, mechanisms of functioning, and evolutionary development features of self-regulation systems found in invertebrates and vertebrates. In the research process, the interrelationship of the nervous and hormonal (endocrine) systems in the animal organism, the processes of adaptive response to environmental influences, and the functional levels of biological regulation are studied based on a comparative approach. It has been established that relatively simple reflex mechanisms predominate in invertebrates, and complex control processes are carried out in vertebrates through the central nervous system.*

Keywords: *invertebrates, vertebrates, self-regulation, biological regulation, nervous system, endocrine system, reflex, adaptability, homeostasis, evolution, physiological mechanisms.*

Introduction. Adaptation of living organisms to external and internal environmental influences is one of the important biological processes that sustains their vital activity. These processes are carried out primarily through self-regulation systems formed in the organism. In the animal kingdom, such control mechanisms are closely related to the activity of the nervous and hormonal systems, which play a leading role in ensuring the integrity of the organism, coordinating physiological processes, and adequately responding to environmental factors.

In invertebrates and vertebrates, self-regulation systems differ significantly in structure and functional capabilities. In invertebrates, control processes are mainly carried out through relatively simple nerve branches and reflex mechanisms, while in vertebrates, complex and multi-stage regulation processes are formed through a centralized nervous system and a developed endocrine control system. These differences indicate the improvement of control mechanisms with the increasing complexity of the organism in the process of animal evolution.

Currently, in research in the field of animal physiology and neurobiology, the comparative analysis of self-regulation systems is one of the important scientific directions. Because such studies allow not only to understand the functional harmony in the animal organism, but also to identify the general laws of biological regulation, explain the mechanisms of homeostasis maintenance, and scientifically explain the processes of evolutionary adaptation.

Literature review. From the late 19th and early 20th centuries, the scientific study of self-regulation systems in animal organisms became one of the important research



directions in biology and physiology. The theoretical foundations of this issue are primarily related to fundamental research devoted to the study of the activity of the nervous system.

The mechanisms of control of the nervous system, based on reflex activity, were deeply studied by Ivan Petrovich Pavlov. His doctrine of "conditioned reflexes" laid the scientific foundation for the processes of self-regulation in vertebrates. Pavlov substantiated the mechanisms of the organism's adaptation to the external environment and maintaining internal balance through the nervous system with experimental evidence[1].

Charles Darwin's views are of particular importance in the study of the evolutionary features of the nervous system and control mechanisms in invertebrates. Further research based on his theory of evolution made it possible to explain the development of the nervous system from simple to complex. Darwin's ideas served as a methodological basis for a comparative analysis of control mechanisms in invertebrates and vertebrates[2].

One of the scientists who deeply studied the functional aspects of the structure of the nervous system is Charles Scott Sherrington. In his work "The Integrative Action of the Nervous System," the integrative function of the nervous system, that is, the functioning of individual nerve centers as a single control system, is scientifically substantiated. These views indicate the centralized nature of self-regulation processes in vertebrates [3].

The scientific works of Ernest Henry Starling occupy an important place in the study of issues of endocrine regulation. His introduction of the concept of "hormone" to science revealed the interconnection of the nervous and hormonal systems. Starling's research is one of the main sources for explaining the mechanisms of long-term regulation in the body [4].

In the study of the physiology of invertebrates, the works of Albrecht Bethe and Karl von Frisch are of particular importance. In their research, the transmission of nerve impulses, reflex responses, and biological regulation of behavior in insects and other invertebrates were scientifically analyzed [5].

In the field of modern biology and neurophysiology, the work of Eric Kandel serves to explain self-regulation systems at the molecular and cellular levels. His research on invertebrates revealed the role of the nervous system in learning and memory processes, demonstrating the universality of biological control mechanisms [7].

In general, the scientific works of the above-mentioned scientists serve as a solid theoretical basis for explaining the formation, development, and functional features of self-regulation systems in invertebrates and vertebrates. At the same time, the analysis of the literature shows the need for a more in-depth study of this topic based on a comparative and systematic approach.

Main Part. The vital activity of living organisms is closely related to their ability to respond flexibly to external and internal environmental factors, and these processes are carried out through self-regulation systems. In the animal organism, these systems are formed on the basis of the coordinated activity of the mechanisms of nervous and hormonal regulation, ensuring the coordination of physiological processes, the stability of the internal environment, and flexibility. In the process of evolutionary development, self-regulation



systems have evolved from simple to complex, which is clearly manifested in the example of invertebrates and vertebrates.

In invertebrates, self-regulation processes are mainly carried out through simple forms of the nervous system. These mechanisms, operating on the basis of the diffuse nervous network or ganglionic nervous system, ensure the speed of reflex responses. The transmission of nerve impulses is more localized, and the processes occurring in individual parts of the body are regulated independently. Although such a management system does not have complex integrative capabilities, it is distinguished by its energy efficiency and ability to quickly adapt to environmental changes. At the same time, invertebrates also have hormonal regulation processes, which play an important role in the regulation of growth, development, and metabolism.

In vertebrates, self-regulation systems are highly centralized, and the central nervous system, formed on the basis of the brain and spinal cord, plays a leading role. The reception, processing of nerve impulses, and the formation of response reactions are carried out through complex reflex arcs and higher nervous activity. Neurological regulation, closely connected with the endocrine system, ensures long-term and stable regulation in the body and plays an important role in the processes of maintaining homeostasis, adapting to stressful situations, and coordinating behavior. Such integrated control mechanisms in vertebrates allow them to live, actively move, and form social relations in complex ecological conditions.

Comparative analysis shows that in invertebrates, self-regulation systems are more reflexive and local in nature, while in vertebrates they are more centralized and systemic. The complexity of the nervous system leads to an increase in the speed and accuracy of information processing, and a higher level of adaptability. However, in both groups, the mechanisms of biological regulation are formed in accordance with the living environment and biological needs of the organism, which indicates that self-regulation systems are based on universal laws.

Thus, although the self-regulation systems of invertebrates and vertebrates differ in structure and functional capabilities, they all serve a single biological purpose aimed at ensuring the stability of the organism's vital activity. Comparative study of these systems allows for a deeper understanding of the laws of evolutionary development of biological control mechanisms and serves as an important theoretical basis for modern biological and neurophysiological research.

Conclusion. The conducted analyses showed that in invertebrates and vertebrates, self-regulation systems are an important biological mechanism ensuring the stability of the organism's vital activity. According to the research results, control processes in invertebrates are mainly carried out through simple nerve branches and ganglionic systems and are characterized by rapid reflex responses. Such mechanisms are energy-efficient and effective in adapting to rapidly changing environmental conditions.



In vertebrates, self-regulation systems are highly centralized, and complex and stable regulatory processes are formed on the basis of the integrated activity of the nervous and endocrine systems. These systems play a leading role in maintaining homeostasis, adapting to stress factors, and managing complex behavioral patterns. The centralization and functional complexity of the nervous system provide vertebrates with wide opportunities for adaptation to environmental conditions.

In conclusion, although the self-regulation systems of invertebrates and vertebrates differ in structure and functional capabilities, they are all based on the same biological laws aimed at maintaining the stability and viability of the internal environment of the organism. The results of this study contribute to a deeper understanding of the evolutionary development of biological control mechanisms and can serve as a theoretical basis for further scientific research in the field of animal physiology and neurobiology.

References:

1. **Павлов И.П.** Условные рефлексы: опыт объективного изучения высшей нервной деятельности животных. — М.: Наука, 1951. — 384 с.
2. **Darwin C.** On the Origin of Species by Means of Natural Selection. — London: John Murray, 1859. — 502 p.
3. **Sherrington C.S.** The Integrative Action of the Nervous System. — New Haven: Yale University Press, 1906. — 411 p.
4. **Starling E.H.** Principles of Human Physiology. — London: J. & A. Churchill, 1915. — 1432 p.
5. **Bethe A.** Allgemeine Anatomie und Physiologie des Nervensystems. — Leipzig: Georg Thieme, 1903. — 287 p.
6. **Von Frisch K.** The Dance Language and Orientation of Bees. — Cambridge: Harvard University Press, 1967. — 566 p.
7. **Kandel E.R., Schwartz J.H., Jessell T.M.** Principles of Neural Science. — 5th ed. — New York: McGraw-Hill, 2013. — 1760 p.