



**KAPITEL 7 / CHAPTER 7<sup>7</sup>**  
**REVIEW PAPER ON BASIC ASPECTS OF PHYSIOLOGICAL AND  
BIOCHEMICAL PROCESSES IN THE ORGANISM OF HYDROBIONTS  
DURING ADAPTATION-COMPENSATORY PERIOD**

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## **Introduction**

Considering this topic, comprehensively assessing the state of previously unresolved aspects, it is possible to focus attention on the leading role of rapidly developing technologies, transformations of climate parameters, ecological and biological changes of objects. Against the background of such modifications of abiotic factors, certain links of the physiological and biochemical state of the organism of hydrobionts are improved (Honcharova O. V., 2022). The moment of "physiological compliance", adaptation of hydrobionts to those abiotic and biotic factors that create a certain habitat is important. At the same time, the issue of monitoring both natural water areas and artificial, transformed ones, including the conditions for the cultivation or growth of hydrobionts in recirculation systems (RAS), of the basin type (Fedonenko O.V., 2010; Sondak, V.V., 2008; Buzevych I. Yu., & Tretiak O.M., 2005). Such studies predict the availability of high adaptation capabilities of hydrobionts to innovative solutions, which is currently relevant. In the context of the conditions of additional feeding, for example, with biologically active substances, additives of a complex combination, this topic is of practical importance. One of the tasks for scientists and practitioners is the selection of exactly such a method of growth, which will ensure high resistance of the organism of hydrobionts to negative factors of influence in natural conditions, during cultivation (additional growth) in RAS, as well as in stagnant conditions, natural water areas, reservoirs, or before stocking to transformed reservoirs. In any situation, in the process of adaptation, the organism of hydrobionts must show a level of compensatory mechanisms to the operating factors. Under such conditions, the functional system actively involves all synthetic processes at various levels, including enzymes of energy, protein, carbohydrate and phosphorus exchanges, etc. It is worth noting that based on the level of activity of a complex of enzymes and hormones, it is possible to form reasonable conclusions about the adequacy, and what is no less important, the timeliness of the appropriate reactions of the organism of

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hydrobionts to the action of abiotic and biotic factors (Guerriero G. & Garcia G., 2018).

Taking into account the presented information on the topic, in order to fully disclose the selected issue, the tasks were as follows: to carry out a comprehensive analysis and comprehensively consider the main aspects of the formation of the resistance of the organism of hydrobionts under the influence of various factors. To reveal the mechanism of action of the main physiological and biochemical processes in the context of understanding the functionality of the organism of hydrobionts in general. Summarize basic concepts and presented judgments regarding the activity of metabolic processes, regulation of enzymatic activity in the body of hydrobionts against the background of the conditions of influence of abiotic and biotic factors, taking into account the time factor, modern conditions of transformation of environmental parameters. To present the scheme of neuro-humoral regulation in the body of hydrobionts.

### ***Results and discussion***

Analysis of the current state of production of aquaculture products demonstrates that individual technological links of the process are being transformed and improved, and innovative solutions of such technologies are being implemented. However, the question of the resistance of the organism of hydrobionts under the influence of a certain factor or in the conditions of existence remains timeless. In the context of the importance of the formation of the mechanism of complex biochemical and physiological reactions in response to the action of such abiotic and biotic factors, the question acquires practical relevance (Honcharova, O.V. et al., 2021; Buzevych I. Yu. & Makarenko A. V., 2020; Poff N.L. & Zimmerman J. H., 2010; Korzhov Ye. & Honcharova O., 2005).

First of all, it will be appropriate to note the leading role in the organism of hydrobionts of physiological and biochemical processes of different levels, structural organization, plasticity and reactive response to stimuli. Undoubtedly, the improvement of the technological elements of growing and breeding aquaculture objects, the introduction of modern solutions, IT technologies in production - all this is inevitable and natural. In this context, the hydrobiont organism itself is a functionally active system. Moreover, the level of response to a certain factor (stimulus) depends on their adaptation capabilities. Research works focused on this topic reflect the important role of regulators of adaptation and metabolic processes in the body not only of introducers (during acclimatization), but also of any object of the aquatic ecosystem in artificial and natural conditions of cultivation (during adaptation). Studies of



neurohumoral regulation with an emphasis on the hormonal background, enzymatic activity and parameters of development and productivity of hydrobionts come to the fore (Farombi E. et al., 2007; Barton B.A. & Iwama G.K., 1991).

The question of the deep influence of abiotic and biotic parameters on the functional state of hydrobionts is gaining relevance. Numerous studies reflect the results of the authors, who emphasize both the dominant role of climate parameter transformations and the rational use of biological resources, the potential of water areas, and the species composition of ichthyocenoses. The authors note the topics of impact of man-made load, heavy metals on aquatic systems and hydrobionts as relevant research (Honcharova O.V. Paraniak R.P. & Hutyi B.V., 2019; Atanasov V. et al., 2012; Atanasov V. et al., 2011).

Along with such concepts, the role of the feed factor, biologically active substances, nutritional supplements in the growth, breeding and cultivation of hydrobionts in the conditions of recirculation systems (RAS), basin and pond farms was also noted (Zharchynska V.S. & Hrynevych N.Ye., 2022; Zaykov N.A., 2008). The positive results of research work on the implementation of hydrobiont feeding optimization in order to improve the functional state of the organism of hydrobionts have been noted in the literature (Honcharova O.V. et al., 2020; Symon M.Yu. et al., 2020; Wan A.H. et al., 2019; Fegan D.F., 2006; Hrynzhevskiy M.V. & Pekarskiy A.V., 2004; Sorgeloos P. et al., 2001).

The experimental researches of the authors demonstrate a leading role in improving the parameters of development speed, fattening ratio, feed conversion, average daily growth of hydrobionts precisely by indicators of physiological and biochemical processes. With such transformations, there is a restructuring at the cellular level of metabolic indicators, enzymatic reactions, and morphometric indices of blood. As a result of the different level of plasticity of homeostasis parameters in the organism of hydrobionts to the action of the feed factor, climatic changes, there is improvement or deterioration, in general, of synthetic processes in the organism. At the same time, the emphasis is on the correlation of physiological and biochemical parameters and on the qualitative composition of the water environment (hydrochemical, hydrobiological indicators, etc.) (Honcharova O. V. & Tushnytska N. I., 2018; Hoseinifar S.H. et al., 2017; Palamarchuk R. A. et al., 2016; Ringo E. et al., 2010; Ognean L. & Barbu A., 2009; Papandroulakis N. & Divanach P., 2002; Anaga A. & Abu G. O., 1996).



It should be noted that in aquaculture, during scientific and research works, the question of the state of the physiological and biochemical parameters of the organism of the objects being studied is always relevant. The scientific works of the authors reflect the results of experimental research on the synergism of the concentration of biologically active substances and morphometric indicators of biological fluid, tissue, biochemical parameters of hydrobionts with the influence of factors of abiotic and biotic composition, etc. Moreover, as factors there can be comprehensive elements of influence: in addition to those listed above, it is advisable to add stress, ecological and biological incompatibility with the conditions of the water ecosystem, genetic incompatibility, ichthyopathological signs, etc.

Summing up, it should be noted that any setting of the experiment, observations for the purpose of scientific research justifications must be timely and necessarily comprehensive. Scientific and experimental studies of domestic and foreign authors demonstrate the importance of the adequacy of the development of adaptive reactions at the biochemical and physiological level, the development of stress reactions in the process of adaptation of hydrobionts to changes, the influence of abiotic and biotic factors (Honcharova O. V., 2022; Stara A. et al., 2012; Barcellos L. J. et al., 2012).

In the context of the discrepancy between the plasticity of the whole complex systems of the body and the "strength" of the stimulus, it is important to study the endocrine regulation of metabolism in depth. The authors attribute this to the active synthesis of stress hormones, such as cortisol. Taking into account that during adaptive reactions, any organism of hydrobionts reacts inextricably, has a correlative relationship with the regulators of physiological and biochemical processes, it is important to study their reproductive capacity, productivity, speed of development, etc. It is known that under the conditions of exposure to negative factors on the body of fish (when their body is not able to respond adequately to a certain strength of the "stimulus"), the hormonal background, first of all, changes through the concentration of hormones secreted by the pituitary gland, adrenal glands, thyroid gland, etc.).

Therefore, in scientific and practical research, as a rule, the emphasis is on studying the state of lipid, carbohydrate, and protein exchanges. Each of them has a specific relationship with a separate organ, target cell, system. Therefore, when an "element" new to the organism is incorporated into a certain process, it can contribute to both the improvement and deterioration of certain vital processes, act as an inhibitor or catalyst of metabolic processes at various stages of the ontogenesis of hydrobionts. Practical results reflect exactly this principle of action, correction of biologically active



physical, probiotic and other drugs under the conditions of introduction to the general farm ration of hydrobionts. Under the conditions of the study of the level of influence of man-made load, climatic transformations in modern realities in the water area, complex analyzes with appropriate forecasting of the likely consequences on the ecosystem as a whole, ichthyofauna, hydrobiological condition, etc., come to the fore. Research from such an angle usually has a systematic nature and is based on the need to develop a recommendation (Hrytsyniak I.I., et al., 2012; Lauzeral C., 2012).

For any final purpose of research (presentation of the justification of the obtained results, development of methodological recommendations for improving the state of the aquatic environment, expanding or stabilizing the ichthyocenosis, increasing the efficiency of production of aquaculture products, increasing productivity or reproductive capacity, adaptation capabilities, resistant organisms of hydrobionts), it is necessary to carry out complex studies of the state of functional activity of the organism of the object being studied, analysis of the quality of the environment where it is located, favorable conditions for reproduction, accumulation of body weight, etc. Taking into account the climate transformations of today, the question acquires relevance and practical value. Research works confirm the importance of harmonizing abiotic and biotic factors against the background of adaptation of hydrobionts to certain living conditions (Kozii O.M., 2020; Fernandino J. I. et al., 2013; Lushchak V.I., 2011; Brander K., 2010).

The key role in the outlined processes is played by the physiological state of the organism with the corresponding mechanism of regulation of the life processes of hydrobionts, from which the formation of the following, no less important parameters is pushed forward. Analyzing the results of scientific and experimental research by the author of this article and other scientists, we will pay attention not only to the actual parameters of hydrobionts under the conditions of studying the influence of a certain factor, but also to the physiological and biochemical mechanisms of regulation of metabolic processes. When interpreting the selected marker parameters of the functional state of the organism or forming reasonable conclusions, complexity is also given by understanding the leading links in the course of a particular process, as a result of which the entire functional system in the organism of the object being studied is adjusted.

In aquaculture, such research experiments are mostly related to the study of the influence of the feed factor, conditions of cultivation, growth of hydrobionts, assessment of the favorable hydrochemical environment of a certain water area,



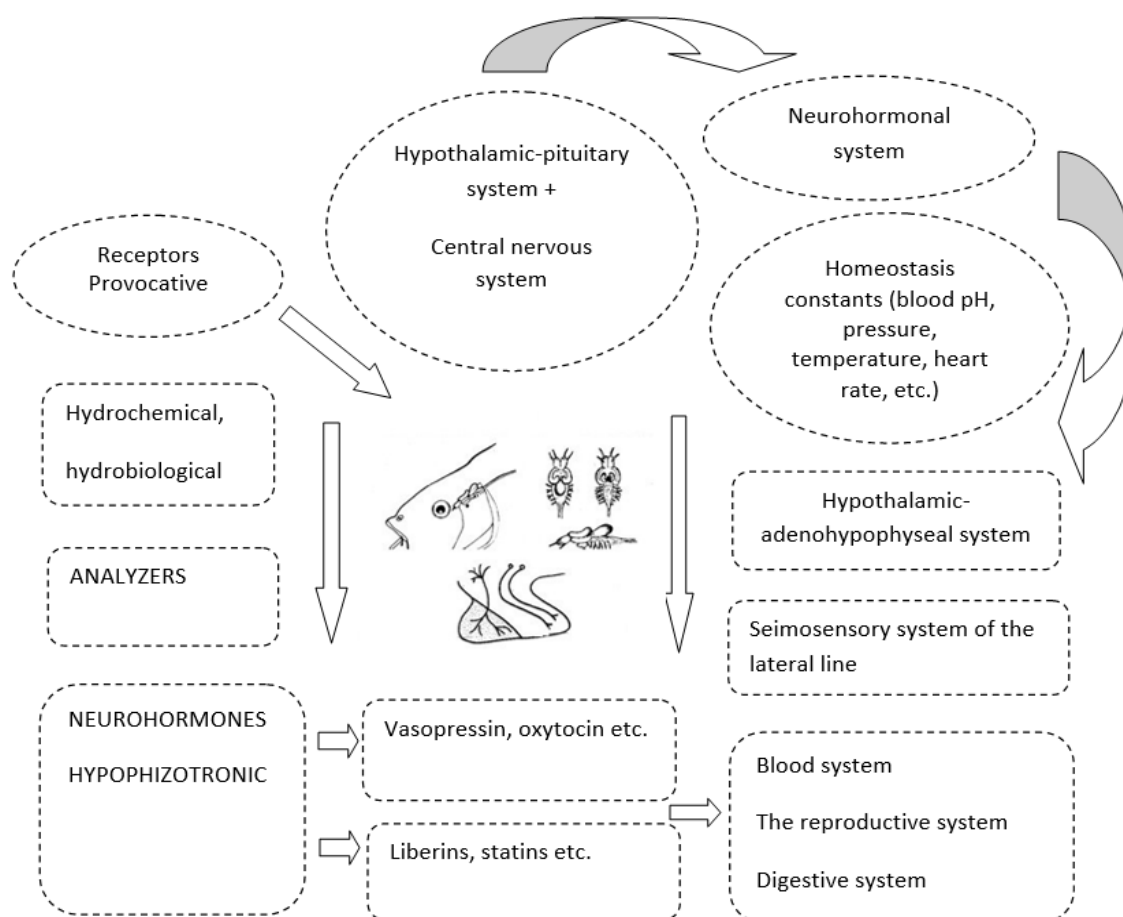
comparative characteristics of the effectiveness of the influence of abiotic and biotic factors, etc. One of the vectors of research on the analysis of the effectiveness of the implementation of most cases of improvement of feeding conditions is the physiological and biochemical experiments of enzymatic activity, the state of the gastrointestinal tract in the organism of hydrobionts.

Any organism is a functionally active system that responds to an action (for it, it is a threshold, suprathreshold force stimulus). As a result, at different physiological and biochemical levels, all processes are regulated by the neurohumoral system. At the same time, each vector has a specific influence, which depends on the nature of the occurrence and the final goal. For example, in the study of metabolic processes, there are basic marker parameters that make it possible to assess the activity of metabolism (protein, carbohydrate, lipid, mineral exchanges), as well as to analyze the level of enzymatic activity (substrate inhibitory specificity, enzyme systems of the gastrointestinal tract (channel), muscle parts, etc.). Already as a result, based on the obtained data, it will be appropriate to investigate the rate of mass accumulation, the level of average daily growth of hydrobionts, etc. Adhering to such an algorithm of actions, the organism of hydrobionts can be considered as a multi-level complex functional system, the links of which are sequential, sometimes have correction with various parameters, physiological and biochemical processes, regulation mechanisms (Dobrianska O.P. et al., 2021; Kozii O.M., 2020; Kozyi M.S., 2011, 2009; King H.R. et al., 2007; Hontela A., 1997).

The level of plasticity of a certain species of hydrobionts depends on its adaptation to environmental conditions, to the action of a certain factor, as well as the possibility of reproduction, reaching the commercial mass of optimal parameters. Under the conditions of maintaining the viability of young hydrobionts and the formation of ichthyofauna in conditions of man-made load, one of the main factors that determines the level of survival of planting material, especially during the adaptation period after introduction, is the influence of predatory species of hydrobionts (Fedonenko O.V., 2010; Buzevych I. Yu., & Tretiak O.M., 2005).

Neuro-secretory innervation of vegetative centers occurs through the hypothalamus-neurohypophyseal and hypothalamus-adenohypophyseal systems, which collectively represent the hypothalamus-hypophyseal system in the organism of hydrobionts (Fig. 1).





**Fig.1. Scheme of neurohumoral regulation of the organism of fish: pituitary - hormones - blood (developed by the author)**

Before considering in more detail the classification and role of some hormones, as an example, it will be appropriate to analyze the mechanisms in the body of fish, which work as a whole coordinated system. Therefore, the basic physiological and biochemical processes determine the physiology of hydrobionts in general, their productivity, reproductive capacity, and the speed of development in ontogeny. Physiologically, it is justified that all processes are based on the reflection and processing of signals that arrive at a specific target cell, receptor field or other "place of analysis and synthesis of information" (David H. Evans & James B. Claiborne, 2005). Target organs in the body can be the adrenal glands, kidneys, hematopoietic organs, the nervous system, the immune system itself (Karpovskyi V.I. et al., 2014; Dekhtiarov P.A. et al., 2008).

For example, when hydrobionts are under the influence of negative factors of the ecosystem (pollution, man-made load, intoxication, etc.), such substances and compounds penetrate through cells, organs, organ systems of substances to the



digestive, respiratory, excretory systems, etc. In turn, the "chain" reaction begins with the restructuring of metabolic processes and, in general, homeostatic balance with the vector of preservation of vital functions in hydrobionts.

Implementation of all processes in the body of fish is carried out directly on the basis of unconditional and conditioned reflexes. For this, every organism, without exception, has a reflex arc (Mazurkevych A.Y., 2012). This anatomical structural formation consists of specific links, groups, formations, in particular: receptor; sensitive (afferent) neuron; central nervous system (CNS), interneuron; motor (efferent) neuron; working organ (muscle, gland, etc.). In this context, the neurohumoral influence on certain organs and the functioning of systems is decisive. In general, it should be noted that hydrobionts are functionally active in certain hydrochemical, hydrobiological and other conditions, depending on the strength of stimuli that exert a constant or variable influence on individual systems.

Unconditionally generalized factors that affect the functional state of the organism of any hydrobiont have a certain species specificity, depend on the conditions of cultivation, biological and economic features of the objects of study. At the same time, the plasticity and inertness of nerve centers in the body of hydrobionts, the level of generation of specific biologically active substances in the bloodstream, etc., are important.

Thus, the regulation of metabolic processes is one of the important parameters that depends on a considerable number of factors. For example, the ecological conditions of the water area are directly correlated with the ability of the fish body to provide neurosecretory innervation of the vegetative centers of the brain and the limbic system in response to each of the stimuli (hydrochemical parameters, trophic features of the water area, etc.).

It is common knowledge to understand the actual essence of neurohumoral regulation of physiologically important processes in the body of hydrobionts, which takes place through the medulla oblongata, middle cerebellum, intermediate and anterior parts of the brain. Thus, depending on the dominant, the impulse reaches a certain part of the brain of hydrobionts, after which it is processed, transformed, synthesized and through afferent, efferent, feedback neurons and synapses, innervates the body system (Mazurkevych A.Y., 2012). In the context of neurohumoral regulation of the functions of hydrobionts, it is also worth mentioning the physiological processes that shape, for example, the reproductive capacity, reproductive capacity of hydrobionts in response to the factor of the water environment where they are (oxygen





concentration, temperature, pH, etc.). Among such vital processes, the maturation of sexual products of fish, the transition of gonads from the final IV and V stages (readiness of fish to ovulation) should be noted. Today, in the conditions of climatic transformations, this becomes especially relevant. An important condition for the full implementation of each of the described processes is the presence in the water area of the entire complex of factors for creating a favorable environment. In particular, the absence of at least one makes the decisive effect of the next one impossible. Therefore, synergistic activity of the complex of all parameters, balancing and compliance with the maximum permissible limits of each of them is extremely important. According to the parameters of ecological tolerance (the ability of the fish organism to adapt to changes in environmental conditions), it is possible to conduct complex studies, to substantiate the obtained results in specific abiotic and biotic conditions.

Therefore, the secretion of hypothalamic releasing hormones in response to the action of any stimulus contributes to the activation of the hypothalamic-pituitary system, which in turn ensures the transport of biologically active substances to the adenohypophysis. At this moment, the releasing factor is activated and the synthesis and secretion of the corresponding tropical hormones by the peripheral (endocrine) glands of hydrobionts takes place. The basic aspects of such a complex physiological and biochemical process are decisive in ensuring homeostatic balance in the body (Sherwood N. M. & Hew C.L., 1994).

Gonadotropic hormone (follicle-stimulating and luteinizing (glycoprotein)) has a direct effect on the reproductive function of male and female fish, particularly on the formation of eggs and sperm. In females, under the influence of follitropin, the development and maturation of follicles in the ovaries (oogenesis) occurs, in males - the formation and maturation of sperm (spermatogenesis). It is definitely worth emphasizing that, in addition to the neurohumoral regulation of the secretion of releasing hormones, the course of all other processes is reflected in the composition and morpho-functional characteristics of blood. In particular, the blood provides transportation of hormones to target organs and other systems. The level of their concentration and the speed of such biochemical reactions depends on a whole complex of factors. At the same time, there is a certain correlation with the qualitative and quantitative characteristics of both the environment and the objects located in a specific water area. In the context of not only physiological-biochemical, morphological or other, but also parameters of hydrochemistry. For example, in the context of the formation of reproductive capacity, during the maturation of sexual products in male



and female fish, the rate of oxygen consumption and release of carbon dioxide and ammonia (as end products of metabolism) will have a significant difference. Moreover, the conditions affecting the functional state of the hydrobiont organism will always contribute to a certain correction of physiological and biochemical processes.

For example, the growth of young hydrobionts in RAS will contribute to the improvement of the resistance of their organism to the action of factors after the stocking of water areas with such young, and the transformational signs will be typical for introducers. Under the conditions of the use of adaptogens, dietary supplements, the body of the grown-up youth will have a high resistance to new factors of the aquatic ecosystem after stocking. Currently, not all breeding programs are rational in the context of investment in additional resources followed by stocking. Everything depends on the type of hydrobionts, the conditions of the natural reservoir and, in general, on the purpose of such an event.

Thus, it can be concluded that the general specific appropriate reaction of the fish organism creates a general background on which all other reactions in the organism of hydrobionts develop and largely depend on it. The ability of the fish organism in a certain range to adapt to new conditions, or to respond to stress factors, sharp changes in the parameters of the aquatic environment, largely depends on the complex of individual physiological mechanisms, on the level of resistance of their organism (Vinogradov et al., 2019; Selye H., 1950). Numerous studies by foreign authors reflect the important role of the adaptive system in the organism of hydrobionts. Depending on the influence of factors to which the organism will be able to adapt or adaptation will not occur, successive stages of adaptation and compensatory reactions are formed. Undoubtedly, stress can be one of the body's responses. According to the definition of the phenomenon itself, stress is a non-specific protective, adaptive, neurohumoral reaction of the body in response to the action of stimuli of different strength and nature, which, in turn, can significantly weaken indicators of homeostatic balance (homeostasis) (Romero L.M., 2004). In this context, it should be noted about the significant role of physiological and biochemical processes of self-regulation of the organism of hydrobionts, its interaction with the environment under the influence of biotic and abiotic factors. Along with the outlined markers, organs of the digestive tract are also important indicators of the functional state of the body. In the conditions of stressful loads on physiological parameters and processes, a certain reactivity is characteristic of the intestine, stomach and digestive glands of hydrobionts, which in turn is consistent with the reserves of the general functional capacity of their organism.



Certain factors adjust the functionality of the entire organism of hydrobionts: the digestive system, blood, formation of development speed, reproductive capabilities, etc. (Ziółkowska E. et al., 2020).

It is well known that the study of the level of adaptation mechanisms to factors of various origins is one of the key aspects for a comprehensive analysis of the interaction of the hydrobiont organism and the aquatic ecosystem. In aquaculture, in such scientific and practical studies, the morphological and histological parameters of hydrobionts are the most relevant along with those outlined (Georgieva E. et al., 2016; Kozyi M.S., 2009).

The functional status of the organism of hydrobionts is a kind of platform for the course of complex processes at different levels of organization, in particular, biochemical, physiological, morphological, histological, etc. During acclimatization of hydrobionts to new conditions, adaptive and compensatory mechanisms may not work. Under such circumstances, stressful ethology begins, which is not the norm for the organism of hydrobionts in optimal environmental conditions.

Based on the biological characteristics of fish, specific neuro-humoral centers are formed in their body, which are separate structural formations of the central nervous system, which already directly transmits nerve impulses to endocrine organs. This "nerve path" (brain - gland) passes every impulse according to the principle of a reflex arc. For example, under conditions of influence of different temperatures on the body of hydrobionts, temperature adaptation with different threshold indicators will be formed. So, hormonal regulation has a control apparatus. The central structure of the nervous system, which regulates the functions of the endocrine apparatus, is the hypothalamus. This function of the hypothalamus is related to the presence in it of groups of neurons that have the ability to synthesize and secrete special regulatory peptides - neurohormones. The hypothalamus is both a nervous and an endocrine center (Dekhtiarov P. et al., 2008).

The basic aspects of the regulation of physiological functions in the body of hydrobionts ensure the maintenance of homeostatic balance through the interrelationship of nervous and humoral mechanisms (Mazurkevych A. Y., 2012). For example, cortisol content is a marker indicator of functional changes, the concentration of which increases in response to various forms of stress factors. This hormone regulates the functional activity of organs, in particular, the liver, glycogen in muscles, increases metabolic activity, stabilizes or, on the contrary, destabilizes reproductive function (Martinez-Porchas M. et al., 2009). Under any conditions, physiological and



biochemical substantiation will only supplement and provide in-depth ideas about the effectiveness of the effect or the general state of the organism of hydrobionts, parameters of their productivity etc.

Considering today's conditions, transformational changes in climatic parameters all over the world, issues of improving the adaptive and compensatory capabilities of hydrobionts, increasing their resistance to the influence of abiotic and biotic factors are relevant and have practical value and scientific significance. Specific adaptation is the process of adaptation of the organism to any "adequate" factor in the external environment. These are, for example, temperature changes (cooling, heat), climate changes (introduction, transportation of objects from one region to another), vaccination, etc. (Pagé C. & Terray L., 2011; Mouthon J. & Daufresne M., 2006; Lenhardt M. et al., 2005; Nakićenović N. & Swart R., 2000).

In the process of evolution, a non-specific adaptation developed - the process of formation of one factor under the influence of other factors analogous to the first. Such a process is decisive in the issue of preservation of species, populations, and their viability under extreme conditions of sufficiently long duration. As research shows, such aspects are important in the development of strategic plans for the development of aquaculture for each country, optimization of technological aspects of production of aquaculture products, introduction of adaptogens, biologically active feed additives, etc.

## **Conclusions**

The organism of hydrobionts is a single complex functional system, each parameter of which is interconnected with another and regulated by neurohumoral pathways. The center of regulation of stability of homeostatic balance must provide an adequate response to the influence of a stimulus (abiotic or biotic factor). Under conditions of inconsistency, a state of stress occurs in hydrobionts. The ability of the organism to respond with the same type of systemic non-specific reaction to various stress factors determines the level of adaptation capabilities of hydrobionts. The general non-specific adaptive reaction of the body creates a general background against which all other reactions in the fish body develop and largely depend.

The study of physiological and biochemical processes of adaptation against the background of the influence of various factors (technological, climatic, genetic, etc.) is



of great importance for understanding the processes of self-regulation of the organism of hydrobionts, its interaction with the environment under the influence of factors. Understanding the essence of the processes that occur in the organism of hydrobionts provides an opportunity to more effectively choose the technological aspects of improving a certain technology in aquaculture. Innovative solutions in the industry can contribute to increasing efficiency from their introduction into the technological map, provided that the biological features of hydrobionts and the level of their adaptation capabilities are taken into account.

At the same time, the body of hydrobionts can respond in the form of a stress reaction, which will be an indicator of the lack of positive adaptation to the implemented technological cases of improving the course of physiological and biochemical processes. Because sometimes the body of hydrobionts needs to be prepared for certain changes, to increase resistance to the possible negative effects of individual elements. The functionality of the fish organism is determined by the complexity of all processes aimed at supporting vital functions, self-preservation and adaptive and compensatory capabilities. Undoubtedly, the activity of the course of metabolic processes, in particular, physiological and biochemical ones, identifies the parameters of homeostatic balance in the body of fish.