Influence of developments in the field of high-energy physics on the biochemical parameters of the blood serum of Clarius catfish grown in RAS

O N Rudneva, A A Vasiliev, A V Kudinov and A P Korobov
FSBEI VO Saratov GAU im. N.I. Vavilova, Saratov, Russian Federation
E-mail: rudnevmu@yandex.ru

Abstract. The data on the influence of innovative hydrological developments in the field of high energy physics on the biochemical parameters of blood serum of Clarius catfish grown in a closed water supply installation are presented. The essence of innovative developments in the field of high energy physics consists in the treatment of water in which fish and feed are grown with crystal structures created by a group of Russian scientists. The energy of these crystal structures has a beneficial effect on the biological activity of objects, improving their natural properties. During the experiment, the content of total bilirubin, enzymes aspartate aminotransferase (AsT) and alanine aminotransferase (AlT), total protein, creatinine, glucose, urea, alkaline phosphatase, macro elements (calcium and phosphorus) were determined. The biochemical blood parameters of the fish in the control and experimental groups had significant differences in some parameters, which may indicate a positive effect of feeds with a modified molecular structure and biologically active liquid (BAF) on the organism of Clarius catfish.

1. Introduction
Along with the growth of consumption of fish products on a global scale, aquaculture is actively developing. In this regard, much attention is paid to the industrial production of fish [1-2]. Clary catfish is not whimsical in cultivation and is quite suitable as an object of industrial production, which is not to a small extent promoted by high growth energy, fertility and resistance to environmental factors, to diseases, endurance during transportation [3-8]. In the process of industrial fish farming, primary attention is paid to its physiological state, due to the high density of the content [9]. An important condition for the effective implementation of intensive fish farming is careful control over the physiological state of the rearing objects. The reaction of the organism of catfish raised in RAS to external changes has not yet been sufficiently studied, therefore it is interesting to study the biochemical parameters of blood taking into account the main factors of their environment. Blood, as the most mobile system, reacts more quickly to the action of various factors and, accordingly, is able to demonstrate changes occurring in the fish organism, therefore, its analysis is important.

To provide a complete picture of the physiological state of fish and the reaction of their body to the introduction of feed with a modified molecular structure and biologically active fluid into the diet, studies of the biochemical properties of blood were carried out [6].

Previously, we studied the effect of compound feed and water with a modified molecular structure on the ichthyomass and safety of the livestock, as well as the muscle tissue of the Clarius catfish. The energy of crystal structures created by a group of Russian scientists has a beneficial effect on the biological activity of objects, improving their natural properties. According to the results of studies...
with the same initial weight of fish, feeding the 3rd experimental group with compound feed with a changed molecular structure and growing it in water with a changed molecular structure made it possible to increase the ichthyomass (table 1). The largest increase was given by the catfish of this experimental group, while the feed conversion and safety of livestock in this group were also the best [1].

| Period, weeks | Group          | Control | 1 experienced | 2 experienced | 3 experienced |
|---------------|----------------|---------|---------------|---------------|---------------|
| 1             | 480.0          | 424.0   | 480.0         | 500.0         |
| 5             | 1900.0         | 2060.0  | 2020.0        | 2228.0        |
| 9             | 3060.0         | 4180.0  | 3800.0        | 4020.0        |
| 15            | 4300.0         | 3539.7  | 3940.0        | 4360.0        |
| 20            | 5827.5         | 5220.0  | 5332.5        | 6360.0        |
| Growth, gram  | 5347.5         | 4796.0  | 4852.5        | 5860.0        |
| Safety, %     | 62.5           | 95.2    | 83.3          | 80.8          |

From the data in table 1, it can be seen that during the period of the experiment the most intensive increase in ichthyomass was observed in the 3rd experimental group, where it amounted to 5860.0 grams, which is 10% higher than in the control. Also, in the 2nd experimental group, which received the experimental compound feed, the increase in ichthyomass was greater than in the 1st group, which received the control feed. In the control group, the lowest safety of livestock was noted, amounting to 62.5%, in the second experimental group - 83.3%, in the third experimental group - 80.8%.

The studies carried out confirmed the positive influence of the energy of crystal structures on the development of fish muscle tissue and its chemical composition (figure 1) [8].

![The chemical composition of muscle tissue, %](image.png)

**Figure 1.** The chemical composition of the muscle tissue of the clarion catfish in the middle and at the end of the experiment.

The purpose of this work is to study the influence of innovative developments in the field of high-energy physics on the biochemical parameters of the blood serum of Clarius som. The essence of innovative developments in the field of high-energy physics is the treatment of water in which fish and feed are grown with crystal structures created by a group of Russian scientists. The energy of these
crystal structures has a beneficial effect on the biological activity of objects, improving their natural properties.

2. Materials and methods
The experiment was carried out in the research laboratory "Technologies of feeding and growing fish" FSBEI VO Saratov GAU according to the scheme presented in table 2.

| Group          | Number of individuals | Conditions of keeping and feeding                  |
|---------------|-----------------------|----------------------------------------------------|
| Control       | 30                    | Plain water + control compound feed               |
| 1 experienced | 30                    | Test water + test compound feed                   |
| 2 experienced | 30                    | Plain water + experienced compound feed           |
| 3 experienced | 30                    | Experimental water + experienced compound feed    |

For the experiment, according to the principle of analogs, 120 specimens of Clarius catfish with an average weight of 20.0 g were selected and placed in four aquariums with a volume of 250 liters each. Water exchange and thermal regime were the same in all groups. Each aquarium was equipped with an independent water filtration system and its disinfection using ultraviolet lamps. All aquariums were filled with water from the general city network, and in the aquariums of the 1st and 3rd experimental groups, hermetically sealed glass containers with high-energy treated water in the amount of 2 pieces were additionally installed. The energy from the treated water was transferred to the surrounding water in the aquarium. The treated water was changed every two weeks. During the experiment, the fish were fed three times a day. The fish were fed manually with catfish food. The control and the 1st experimental group received the control feed, and the 2nd and 3rd experimental groups received the same feed, but subjected to high energy processing, with a changed molecular structure.

The daily feed rate was calculated according to the generally accepted method, taking into account the water temperature, the content of dissolved oxygen in it, and the weight of the fish [5]. Fish growth was monitored to adjust daily feeding rates.

Biochemical studies of blood serum were carried out in the middle and at the end of the experiment in the laboratory of the veterinary hospital in accordance with the standard requirements within 24 hours after it was obtained from the fish organism. Blood was taken from three standard individuals from each group (control and three experimental). Blood was taken from hungry fish within 5-10 minutes after catching from the tail stump, mucus was removed, the skin was wiped with alcohol, then the caudal peduncle was cut off along the medial line behind the anal fin, and blood was collected in test tubes. All statistical data were biometrically processed.

3. Results and Discussion
The biochemical characteristics of blood are different in different fish species due to the characteristics of their habitat and lifestyle. It is possible that indicators fluctuate within one species depending on the season of the year, conditions of detention, age, sex, state of individuals and other factors. Blood biochemistry shows the functional state of organs and body systems.

Blood, as the internal environment of the body, contains proteins, carbohydrates (glycogen, glucose, etc.) and other substances in the plasma that are involved in energy and plastic metabolism, in the creation of protective properties. The level of these substances in the blood is determined by the biological characteristics of fish, and the mobility of the blood composition makes it possible to use its indicators to diagnose the physiological state.

During the experiment, the content of total bilirubin, enzymes aspartate aminotransferase (AsT) and alanine aminotransferase (AlT), total protein, creatinine, glucose, urea, alkaline phosphatase, and macro elements (calcium and phosphorus) were determined (table 3).
### Table 3. Biochemical parameters of blood serum of clary som.

| Indicator            | Units     | control   | 1 experienced | 2 experienced | 3 experienced |
|----------------------|-----------|-----------|---------------|---------------|---------------|
| Total bilirubin      | μmol / l  | 6.87±0.55 | 8.83±1.46     | 9.00±6.16     | 7.10±2.33     |
| AsT                  | units / l | 76.67±5.97| 58.47±16.03   | 58.23±11.32   | 40.00±27.11   |
| AIT                  | units / l | 30.80±5.58| 37.30±12.39   | 33.57±8.70    | 27.87±17.34   |
| Total protein        | g / l     | 68.00±3.52| 67.73±6.60    | 77.13±11.10   | 67.90±21.74   |
| Creatinine           | μmol / l  | 104.73±7.62| 117.27±31.96 | 79.57±28.29   | 132.53±63.12  |
| Urea                 | mmol / l  | 5.27±0.67 | 5.93±0.75     | 5.77±1.15     | 5.03±1.00     |
| Glucose              | mmol / l  | 3.70±0.36 | 4.13±0.35     | 3.27±0.95     | 3.10±1.61     |
| Alkaline phosphatase | units / l | 71.37±3.68| 61.43±17.57   | 62.60±7.89    | 63.70±52.17   |
| Calcium              | mmol / l  | 2.87±0.15 | 2.87±0.35     | 2.63±0.15     | 2.47±0.25     |
| Phosphorus           | mmol / l  | 3.30±0.30 | 3.10±0.72     | 2.33±0.93     | 2.43±1.19     |
| Total bilirubin      | μmol / l  | 6.13±0.15 | 8.27±0.64     | 10.67±2.77    | 9.53±1.15     |
| AsT                  | units / l | 67.23±7.21| 49.63±34.04   | 44.37±25.15   | 57.23±18.29   |
| AIT                  | units / l | 25.87±2.48| 38.93±23.84   | 46.47±30.03   | 51.97±12.32   |
| Total protein        | g / l     | 64.77±8.51| 65.87±12.61   | 85.83±12.50   | 72.37±14.28   |
| Creatinine           | μmol / l  | 91.43±6.61| 124.90±25.08  | 124.30±58.09  | 132.83±42.34  |
| Urea                 | mmol / l  | 5.17±1.04 | 7.13±1.31     | 7.50±2.00     | 7.37±0.55     |
| Glucose              | mmol / l  | 3.30±0.61 | 3.70±1.04     | 3.63±1.95     | 3.57±0.75     |
| Alkaline phosphatase | units / l | 66.17±11.52| 52.60±21.00   | 117.64±44.96  | 78.03±14.80   |
| Calcium              | mmol / l  | 3.43±0.46 | 2.93±0.45     | 3.13±0.40     | 3.47±0.51     |
| Phosphorus           | mmol / l  | 3.77±0.23 | 2.73±0.85     | 2.53±1.21     | 3.30±0.36     |

Plasma bilirubin is used to assess liver function. The total bilirubin in fish of the control and 1st, 2nd and 3rd - experimental groups had a significant spread (6.87 μmol / l, 8.83 μmol / l, 9.00 μmol / l and 7.10 μmol / l respectively). The maximum value for both periods of research was observed in fish of the 2nd experimental group of 9.00 μmol / l and 10.67 μmol / l.

An excess of AsT (aspartate aminotransferase) enzyme activity indicates a fairly narrow range of pathological conditions. In healthy fish, the amount of this enzyme in plasma is minimal and does not go beyond the normal range.

The content of AsT in the control and 3rd experimental groups differed significantly (76.67 units / l, 40.00 units / l, respectively), in the 1st and 2nd experimental groups were almost identical 58.47 units / l and 58.23 units / l. The maximum level of AsT activity for both periods of studies was observed in the control group and amounted to 76.67 units / l and 67.23 units / l. The increased activity of the AsT enzyme in fish from the control group indicates that their adaptability and resistance to stress are lower than in the experimental groups.

AlT (alanine aminotransferase), being an endogenous enzyme, is synthesized intracellularly. An increased content of AlT in biochemical analysis indicates a number of abnormalities in the body and the development of serious diseases.

As a result of the analysis, there was a slight fluctuation in the amount of AlT in the control and experimental groups, 30.80 units / l, 37.30 units / l, respectively, in the 1st and 2nd experimental groups were almost identical 33.57 units / l and 32.78 units / l. According to the results of the second study, an increase in the AlT value can be noted in all groups except for the control group, where this indicator decreased from 30.80 units / l to 25.87 units / l.

The AsT / AlT ratio (de Ritis coefficient) is used to judge the severity of organ damage, normally the value of this coefficient is 1.3 - 1.75 units / l [2]. In fish of the control group, the de Ritis coefficient was 2.49 units / l and 2.60 units / l for the two study periods, exceeding the maximum value of the norm by 0.85 units / l, which is possibly associated with a large injury rate. For catfish of
the 1st experimental group - 1.57 units / l and 1.27 units / l, the 2nd experimental group - 1.73 units / l and 0.95 units / l, the 3rd experimental groups - 1.44 units / l and 1.10 units / l, respectively.

Total blood protein takes an active part in the coagulation system, in the body's immune defense.

Creatinine is an indicator of the functioning of the urinary and muscular systems.

The content of total protein in the blood plasma of fish in the control, 1st and 3rd experimental groups was practically at the same level (68.00 g / l, 67.73 g / l and 67.90 g / l, respectively). The result of the 2nd experimental group is 77.13 g / l.

High values of indicators of total protein content in blood serum can be explained by the high potential of protein metabolism in conditions of recirculation, since the load of intensive feeding and high densities of fish keeping is high [7-14].

A similar situation can be traced for creatinine 104.73 μmol / l, 117.27 μmol / l, 132.53 μmol / l and the value of the indicator for the 2nd experimental group is 79.57 μmol / l.

Studies of the second period showed the maximum values for total protein and creatinine in the 3rd experimental group, their values for two study periods were for total protein - 77.13 g / l and 85.83 g / l, for creatinine - 132.53 μmol / l and 132.83 μmol / l.

Determination of the concentration of urea nitrogen is used in laboratory diagnostics to assess the functional capacity of the kidneys. Urea in fish of the control, 1st, 2nd and 3rd - experimental groups was practically at the same level (5.27 mmol / l, 5.93 mmol / l, 5.77 mmol / l and 5.03 mmol / l, respectively). During the second period of research, the value of the urea indicator in all experimental groups increased by more than 2 mmol / l, in the control group it slightly decreased.

Glucose is the body's main source of energy. It was found that the blood glucose level in fish of the 1st experimental and control groups (4.13 mmol / l, 3.70 mmol / l) was slightly higher than in fish of the 2nd and 3rd experimental groups (3.27 mmol / l and 3.10 mmol / l). The maximum glucose value for the entire study period was observed in the 1st experimental group 4.13 mmol / l and 3.70 mmol / l, which indicates a higher level of carbohydrate metabolism.

The alkaline phosphatase index is used to diagnose diseases of the bones, liver and some heart diseases.

According to the content of alkaline phosphatase in the blood serum, there is a difference between the control and all experimental groups (control - 71.37 units / l, 1st - experimental - 61.43 units / l, 2nd - experimental - 62.60 units / l, 3rd - experimental - 63.70 units / l). The minimum value of alkaline phosphatase during the research period was noted in the 1st experimental group, 61.43 units / l and 52.60 units / l. The lower value of the alkaline phosphatase index confirms the better physiological state of the fish in the experimental groups.

Calcium in the blood is an important laboratory indicator, since it takes part in muscle contraction, in the reaction of blood coagulation and clot formation, and activates the activity of certain enzymes and hormones.

The value of calcium in the blood of fish in the control, 1st, 2nd and 3rd - experimental groups was practically at the same level (2.87 mmol / l, 2.87 mmol / l, 2.63 mmol / l and 2.47 mmol / l, respectively). During the research period, the value of the indicator increased in all groups, especially significantly in the third experimental group by 1.0 mmol / l, from 2.47 mmol / l to 3.47 mmol / l. An increase in the content of calcium in the blood of fish of the 3rd experimental group also favorably affects the physiological state of catfish.

With a decrease in the content of phosphorus in the blood, the supply of the body with energy resources worsens, due to which the exchange of energy in the cells is significantly disrupted.

The amount of phosphorus in the blood of catfish of the 2nd and 3rd experimental groups was slightly lower (2.33 mmol / l and 2.43 mmol / l) than the fish of the control and 1st experimental groups (3.30 mmol / l and 3.10 mmol / l). The maximum value for phosphorus was noted in the control group 3.30 and 3.77 mmol / l, while during the study period this indicator increased in all groups, with the exception of the 1st experimental group.

The research results show that the biochemical blood parameters of the fish in the control and experimental groups had significant differences in some parameters, which may indicate a positive
effect of feeds with a modified molecular structure and BAF on the organism of Clarius catfish. Feeding the Clary Catfish with processed food maintains blood biochemical parameters within optimal physiological limits.

4. Conclusion
Our data indicate that the use of feed and water with a modified molecular structure in the experimental groups during the growing period made it possible to optimize certain biochemical parameters of blood, such as AsT, glucose, alkaline phosphatase, and calcium. During the period of the experiment, a stable change in blood biochemical parameters was observed in all experimental groups.

All this confirms the expediency of the use by fish farms of developments in the field of high-energy physics (compound feed and water with altered molecular structures) for the cultivation of Clarius catfish in closed water supply installations.

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