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THE EFFECT OF pH CHANGES ON THE DEVELOPMENT OF *Cyprinus carpio*

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ВЛИЯНИЕ ИЗМЕНЕНИЙ pH НА РАЗВИТИЕ *Cyprinus carpio*

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Abstract. This study was conducted on carp and the embryo-larval stages of fish living in the water bodies of the Nakhchivan Autonomous Republic. Carp, like other lake fish, are among the inhabitants of alkaline water bodies. In the spawning grounds of the species, pH values were most often recorded in the range of 7.4–8.6 units. Researchers have often tried to study the effect of environmental pH on the early development of carp in their experimental studies. In one of them, values in the range of 7.5–8.5 units are indicated as the optimal pH for the fertilization and incubation of carp eggs. The highest survival rate of carp embryos (more than 80%) was recorded in the pH range of 6.0–8.5 units. However, it has been shown that embryogenesis is also possible in a wider range of 5.0–9.5 units, but in this case, the number of deaths and deformed embryos increases at extreme values of the indicator.

Аннотация. Исследование проводилось на карпе и эмбрионально-личиночных стадиях рыб, обитающих в водоемах Нахчыванской Автономной Республики. Карп, как и другие озерные рыбы, относится к обитателям щелочных водоемов. В нерестилищах этого вида значения pH чаще всего регистрировались в диапазоне 7,4–8,6 единиц. В своих экспериментальных исследованиях ученые часто пытались изучить влияние pH окружающей среды на раннее развитие карпа. В одном из них значения в диапазоне 7,5–8,5 единиц указаны как оптимальный pH для оплодотворения и инкубации икры карпа. Наиболее высокая выживаемость эмбрионов карпа (более 80%) была зафиксирована в диапазоне pH 6,0–8,5 единиц. Однако показано, что эмбриогенез возможен и в более широком диапазоне 5,0–9,5 единиц, но в этом случае число смертей и деформированных эмбрионов увеличивается при экстремальных значениях показателя.

Keywords: Water pH, carp, ecosystem, reservoir, effect

Ключевые слова: pH воды, карп, экосистема, водохранилище, воздействие

Material and methods

The study was conducted on freshwater fish, specifically common carp (*Cyprinus carpio*). Samples were selected from individuals of the same age group (approximately 6–8 months), with similar mass and size. The fish were kept in aquariums for 10 days before the experiment to adapt to laboratory conditions and were acclimatized under standard conditions (temperature 22 ± 1^0C, dissolved oxygen $\geqslant$6 mg/L, light regime 12 hours light/12 hours dark). The experiment was organized into three different pH environments: a control group (pH 7.0–7.5), an acidic environment (pH 5.5–6.0), and an alkaline environment (pH 8.5–9.0). Ten-liter aquariums were used for each

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group, and 10 individuals were placed in each aquarium. The pH level was adjusted using special buffer solutions and monitored daily with a pH meter. The fish were fed twice a day with standard industrial feed; the feeding rate was set at 3% of body weight. The experimental period lasted 30 days. During this period, the following indicators were regularly recorded: body weight and length growth, behavioral changes (activity, feeding response), mortality rate, and signs of physiological stress.

The weight and length of the fish were measured every 10 days, and growth dynamics were analyzed comparatively. Water quality indicators (temperature, oxygen content, ammonia level) were monitored in parallel and kept constant so that only the effect of the pH factor on the results could be assessed.

Results and their discussion.

Some indicators of the development of carp prelarvae after the completion of the embryonic period under conditions of constant hydrogen ion concentration.

Hydrion mode, units	*Time – from fertilization to the beginning of hatching, clock*	*Survival, %*	*Number of abnormal embryos, %*
7,0	124,8±1,5*	92	10
7,5	120,6±1,3	95	8
8,0	119,4±1,2	97	10
8,5	119,1±1,2	92	7
9,0	126,3±1,3*	87	16

Note: * - statistical significance difference $P<0.05$

The coefficient of variation of the index was also minimal at pH 8.0 and 8.5, indicating more synchronous development. Survival under all incubation regimes was quite high, with a minimum at pH 8.0 and a maximum at pH 9.0 in alkaline conditions. The number of abnormal embryos during the observation period was small and approximately normal, less than 10%. We noted an excess only in the hydrion regime of 9.0. Thus, the embryonic development of carp proceeded with the best indicators in the pH range of 7.5-8.5. The results obtained are in good agreement with literature data; as mentioned above, this value is most often used as the optimal value for the incubation of carp eggs. Therefore, we used this pH index as a control to assess the role of changing hydrion incubation regimes for the development of carp after hatching [1-4].

In carp postembryogenesis, the endogenous nutrition process continues immediately after hatching, and the high morphogenesis and growth rate characteristic of embryonic development are maintained [5-10].

At the end of the endogenous nutrition period, the air sac begins to fill with air. In carp, this process occurs before the onset of external nutrition. Summarizing the above, we note that heavy metals, entering water bodies, combine with the buffer system of water, then turn into poorly soluble hydroxides, carbonates, sulfides, and phosphates, and also form metal-organic complexes, accumulate in bottom sediments and, in general, in the organs of the fish fauna of the reservoirs of the area, seriously affecting their development [10-12].

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