CORRELATION BETWEEN WATER PHYSICAL CHEMICAL PARAMETERS AND SURVIVAL RATE OF *PTEROPHILLUM SCALARE* AQUARIUM FISH

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Summary

Nowadays, due to the housing restrictions generated by certain species, the aquarium became an alternative of transferring a part of nature to an urban habitat.

This paper brings to the attention of those interested in exotic fish the issues caused by the water chemical features on *Pterophillum scalare* ornamental fish.

In three tanks populated with scalares there have been used different concentrations of the following water quality parameters: hardness, dissolved oxygen, CO_2, Mg, Ca, NH_3, NO_2^-, NO_3^-, Fe, Cl, Cu. Water quality parameters have been assessed by using the Kit-Sera test and NOVA 60 spectrophotometer. For each water quality parameter taken into account, it has been established the fish' survival rate. Also, there has been followed fish' behavior related to the concentration of the assessed parameters.

The study led to the conclusion that it should be paid a special attention in assessing aquarium water physical chemical parameters.

Though distinctive, some quality parameters are interacting and are affecting each other. When one parameter changes, the others should be monitored in order to observe the dynamics.

Certain quality parameters recording overvalues affect fish normal behavior.

Pterophillum scalare fish' survival rate is in inverse ratio to the concentration of the quality water chemical parameters.

Key words: aquarium fish, water, quality parameters, survival rate, behavior

Having in view the development of a real pets' industry and the housing restrictions generated by certain species, the aquarium became an alternative of transferring a part of nature to an urban habitat (1).

While using an aquarium, some issues may appear: fish' morbidity, ornamentation fail, or even death.

An important cause for these incidents is the low level of information about water physical chemical parameters.

By this paper, we aim to forewarn the aquarium owners of the issues related to the water chemical composition and its influence upon *Pterophillum scalare* ornamental fish.

Scalares belong to *Chiclidae* family counting over 1000 fish species, with different colors, behavior and shapes. They don't dig up the sand, attack nor pull up the plants, not even during spawning period.

The increasing of certain quality parameters concentration in the aquarium water might led to the fish' normal behavior alteration (2, 4).

Materials and methods

For the *Pterophillum scalare* species there has been made a correlation between certain physical chemical parameters of the water in the aquarium and fish' survival rate.

The experiment was done in three tanks with different water parameters concentrations, out of which one was the control tank.

The physical chemical parameters followed up were: hardness, dissolved oxygen, CO_2, Mg, Ca, NH_3, NO_2^-, NO_3^-, Fe, Cl and Cu.

In the three tanks, the concentrations of the assessed parameters were: in the control tank - the admitted concentration for the species housed there; in the tank with the first experiment - the concentrations slightly exceed the maximum admitted limit and in the tank with the second experiment - the concentrations has major exceeding of the maximum admitted limit.

In order to assess the parameters had in view there were used both NOVA 60 spectrophotometer and Kit sera test.

Results and discussions

Fish are poikiloterm animals, their body temperature being very close to the temperature of their growth environment. Thus, water temperature is highly related to the fish' entire activity. Each species leads its life within certain temperature limits. For the fish that make the object of the present study, *Pterophillum scalare*, the optimum temperature is 23 - 25°C or 26 - 28°C in the reproduction period.

There is a straight correlation between water temperature value and oxygen concentration. Dissolved oxygen gets below the admitted limit when temperature records higher values than the optimum for the species.

A prolonged period of too high or, sometimes, too low temperatures may lead to morphological changes in fish, by accelerating the metabolic processes.

Regarding the dissolved oxygen concentration in water, it can be noticed that the survival rate decreases from 100% for a 9 mgO_2/l concentration to 80% for a 3 mgO_2/l water. Dissolved oxygen in water is the most important chemical element from which fish' lives depend, helping to the mineralizing of the organic substances.

The quantity of dissolved oxygen is influenced by water temperature. The higher water temperature, the smaller dissolved oxygen quantity.

When the dissolved oxygen concentration in water decreases, fish suffers an acceleration of the respiratory rate, they are piping water, losing equilibrium, which might lead to death by suffocation, having the mouth and the opercula wide open.

For the carbon-dioxide (CO_2) dissolved in the water there have been tested different concentrations: 3mg/l in the control tank, 5 mg/l in the experimental tank no.1 and 9 mg/l in the experimental tank no. 2.

The survival rate is in inverse ratio to the CO_2 concentration: 100% in the control tank, 90% in the first experiment and 80% in the second.

CO_2 in water is important in developing aquatic flora, in generating organic substances within the process of photosynthesis. In high quantities, CO_2 induces fish' suffocation. When CO_2 concentration exceeds 5 mg/l fish starts to pipe water and its respiratory rate increases (3).

Regarding water pH, it has been noticed, according to the values presented in table no. 1, that for a pH of 7 the survival rate is 100%, for a pH of 5.5 the survival rate is 85.5% and for a pH of 9 the survival rate is approx. 90%.

High values of water acidity and alkalinity can induce stress, overproduction of mucus, skin and gills' thickening. For a pH lower than 5.5 fish have abnormal behaviors: they are isolating themselves in the back of the aquarium tending to hold its fins close to the body.

Table 1

The physical chemical properties of aquarium water and survival rate of *Pterophyllym scalare* fish

Assessed parameter	Control Tank	Survival rate %	Experimental Tank 1	Survival rate %	Experimental Tank 2	Survival rate %
Dissolved oxygen	9 mg/l	100	6 mg/l	95	3 mg/l	80
CO_2	3	100	5	90	9	80
pH	7	100	5.5	85.5	9	90
Hardness	8	100	10	100	14	94.5
Mg	50 mg/l	100	100 mg/l	100	120 mg/l	98
Ca	150 mg/l	100	200 mg/l	98.5	300 mg/l	92
NH_3	0.011	100	0.2	95	0.5	80
Nitrates	5.11 mg/l	100	7 mg/l	97	10 mg/l	89
Nitrites	0.003	100	0.1	98	0.3	75
Fe	0.03	100	0.7	96	1.2 mg/l	89
Chlorine	0.11	97	0.15 mg/l	88	0.2 mg/l	76
Copper	0.1	100	0.6	94.5	2 mg/l	78.9

There are also influences of water pH values' changes upon other chemical compounds in water. For example, NH_3 become more and more toxic as the pH value increases. pH variations in water affect also some treatments: in case of a low pH chloramine T becomes more toxic, and potassium hypermanganate is more dangerous in case of a higher pH.

Monitoring pH in an aquarium indicates the moment when water should be changed or when to siphon the substrate. Excessive dirt generates carbonic acid and reducing water pH value.

Water hardness is very important for fish, having a major effect upon water pH and water stability, as well as on the fish osmoregulation - vital in maintaining fish health.

According data in table no. 1, fish survival rate is 100% for a hardness value of 8 - 10 and 94.5% for a hardness value of 14 German degrees. In the case of high values for water hardness, death rate is not significant, but it occur unpleasant effects upon young's growth and reproduction where the hatching rate is very small. The first noticeable sign is spawn whitening.

Magnesium in water reveals, according to the results in table no. 1, a survival rate of 100% for a concentration of 50, respectively 100 mg/l and 98% for a concentration of 120 mg/l.

Magnesium concentration in water is highly related with calcium concentration, both influencing water hardness.

Calcium has a complex role for both aquatic organisms - by entering in their bone structure and participating to their metabolism, and for plants - by participating to the photosynthesis process. It also influences, along with magnesium, water hardness (5).

According to the results shown in table no. 1 regarding calcium concentration in the tank, the survival rate was around 100% for a 150 mg/l concentration, 98.5% for a 200 mg/l concentration and 92% for the 2^{nd} experiment where calcium concentration was 300 mg/l.

In the case of the waters with a high calcium and magnesium concentration level (high hardness level), there can be noticed, especially in young fish, an early bones' ossification, they cease to grow and they don't reach sexual maturity because of their undeveloped genital apparatus.

Fish survival rate at different NH_3 concentrations in water was, according the obtained results, of approx. 100% at 0.011 mg/l; 95% at 0.2 mg/l and 80% at 0.5 mg/l.

Ammonia concentration in water is related to water pH and temperature. For the water with low levels of both pH and temperature, ammonia maximum admitted limit is significant higher than the one in the water with low pH and temperature levels.

Concerning the nitrates, fish survival rate was approx. 100% for a 5.11 mg/l concentration, 97% for a 7 mg/l concentration and 89% for a 10 mg/l concentration and concerning the nitrites, the survival rate was approx. 100% for a 0.03 mg/l concentration, 98% for a 0.1 mg/l concentration and 75% for a 0.3 mg/l concentration.

Nitrites and nitrates high concentrations led to fish' behavior changes: side swimming, water piping and death in about 15 minutes.

Scalares' survival rate related with iron concentration in water was of 100% for a 0.03 mg/l concentration, 96% for a 0.7 mg/l concentration and 89% for a 1.2 mg/l concentration.

At iron concentrations over 0.5 mg/l, there were noticed: swimming at the surface, slow motions, dorsal fin against the body and death after 5 - 6 days.

Iron comes into the hemoglobin composition which circulates the oxygen entered through the gills. It also participates to the photosynthesis process. When water lacks of iron, the aquatic flora turns yellow.

Chlorine, another important parameter for the aquarium water, comes from the potable water in the water supply system. It is toxic for fish in concentrations higher than 0.003 mg/l.

The survival rate depending on chlorine level variations was approx. 97% for a 0.11 mg/l concentration, 88% for a 0.15 mg/l concentration and 76% for a 0.2 mg/l concentration.

When the chlorine concentrations in water are higher, fish start to have chaotic movements; they strike against tank's sides, they are sitting on one side and if within 30 minutes some measures are not taken, they die.

Copper concentration in water could appear mostly from the products used in alga and snails control. If copper remains for a long time in the aquarium, it becomes toxic for the fish. Its toxicity increases as water hardness decreases. Safe copper concentrations are of 0.006 mg/l in water with low hardness and of 0.03 mg/l in water with high hardness. In our experiment, as can be seen in table no. 1, the survival rate was approx. 100% for a 0.1 mg/l concentration, 94.5% for a 0.6 mg/l concentration and 78.9% for a 2 mg/l concentration.

In fish copper toxicosis it can be noticed: chaotic movements and water piping.

Sudden variations of aquarium water physical and chemical parameters lead to behavioral changes and increasing of different diseases incidence and even death.

Conclusions

Aquarium is an enclosed biotope. Thus, any change of a parameter leads to the change of another.

Fish should be compatible with water quality parameters.

The closer the chemical parameters concentration is to the admitted limits, the higher *Pterophyllum scalare* survival rate.

Water pH less than 5.5, as well as nitrates, nitrites, iron, chlorine and copper overvalues lead to the behavioral changes in scalares.

High calcium and magnesium concentrations lead to water hardness increasing with negative effects upon young fish development.

Recommendations

Changing water in the aquarium should be done at least once a week with new filtered and settled water.

Water quality parameters should be continuously monitored.

Water should have a constant temperature.

Substrate should be changed completely at least once a year.

References

1. ***Bulletin of the European Association of Fish pathologists
2. ***Fish farmer
3. **Bud, I.,** Acvaristică (Piscicultură ornamentală), Editura Academic Press Cluj Napoca, 2002.
4. **Bud, I.,** Peştii şi umbrele tainelor subacvatice, Editura Academic Press Cluj Napoca, 2001.
5. **Bura, M.,** Acvacultură specială, Editura Orizonturi Universitare Timisoara, 2002.