Growing aquarium fish on organic food objects

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Abstract. The dependence of the cultivation of predatory aquarium fish on the use of live food in the diet as an organic food object in the aquaterrarium of the Roev Ruchey Park in the city of Krasnoyarsk was studied. When choosing an organic food object for growing ornamental fish, guppies and swordtail fish of the Pecilia family were considered. Their diet consisted of a combination food and meat mix for freshwater fish. Swordtails gave offspring more than guppies by almost 2 times, puberty came 1 week earlier, the life cycle is longer by 2 years. Brilliant cichlazomas of the studied groups received a combined feed in the diet, the fish of the control group were additionally fed a meat mixture for freshwater fish, in the experimental group this mixture and part of the combined feed were replaced with organic food objects - swordtails in the amount of 0.75 g/head per day.

1 Introduction

One of the very first ways to correct the emotional state is aquarium therapy. The Chinese first noticed the beneficial effect. They used fish bowls in their sessions. Watching the life of underwater inhabitants for half an hour helps a person to relax, move away from problems and find harmony [1].

Scientists have given the opportunity to care for aquarium fish to a group of people. An improvement in the emotional state of the subjects was noted a few days later, after a month blood pressure and pulse normalized, migraines disappeared, digestion improved in almost every participant in the experiment [2], therefore, communication with the inhabitants of the aquarium brings great benefits to the psycho-emotional and physical state of a person.

The modern rhythm of life does not in any way contribute to emotional relaxation, since urban people rarely have to communicate with nature. The Municipal Autonomous Institution (MAI) “Krasnoyarsk Flora and Fauna Park Roev Ruchey” has created excellent conditions where you can emotionally relax at any time of the year. The aquaterrarium is a department in the zoo where reptiles, amphibians, marine and freshwater fish live. With the help of an aquarium, you can observe the underwater life of hydrobionts: their behavior, hunting methods, protection from enemies and creating pairs for reproduction. Large amounts of money are spent on keeping and feeding aquarium fish, in order to make their maintenance less costly, the zoo grows live food. For example, for growing predatory fish with cichlase.

Cichlases are loved for their compact size, brightness of colors and lines on the body, interesting behavior and minimum care, the fish are smart and endowed with some

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intelligence [3]. The diamond cichlazoma has an oval, laterally compressed body, with a concave forehead line and a curved back, a large head, and a terminal mouth. The fish is one of the aggressive and large cichlids. When grown in an aquarium, it reaches a length of 20 cm. Adult fish are fed once a day. The fish is omnivorous, eating dry food, which must be alternated with frozen and live food [4]. At the same time, small fish are used as live food, for example, guppies and swordtails, which belong to small viviparous fish from the Pecilia family, and males are smaller than females, and usually reach a length of about 5 cm. Males are able to place reproductive products directly into the abdominal cavity of the female where fertilization takes place. Quickly adapt to changing environmental conditions. It was noted that the meat of swordtails and guppies contains 19.7 g of proteins per 100 g, fat - 6.7 g [5].

The mobility of live food in water is an irritant for fish; it carries not only nutritional, but also psychological meaning. Hunting for living organisms, the fish gets used to respond to movement to a large extent. Since food reactions in animals are leading in behavior, it becomes clear how important it is to correctly form a trophic basis. It was also noted that the use of live food in the diet stimulates an increase in size and body weight in predatory fish, accelerates the onset of spawning, and changes color [6].

2 Materials and methods

The experiment was carried out in the MAI Park "Roev Ruchey" of the Krasnoyarsk Territory, the city of Krasnoyarsk, the goal is to grow ornamental fish on organic food objects. To achieve this goal, the following tasks were set: the choice of an organic food object (guppies, swordtails) for growing ornamental fish (cichlase); to study the effect of feeding swordtails on the appearance, growth dynamics, reproductive qualities of cichlases; make a calculation of the economic justification of the results.

The experiment was carried out in two stages. The duration of the first stage of the experiment was 30 days. During this period, under the same conditions of keeping and feeding, two groups of herbivorous fish were formed according to the method of groups-analogues, 20 animals each [7].

The control group included guppy fish, and the experimental group included swordfish.

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As the main diet, the fish received the combined dry food CERA VIPAN and the meat mixture for freshwater fish, which enriches the diets with complete protein. Feed consumption is presented in table 1.

Table 1. Feed consumption per head of fish per day.

Feed type	Feed quantity	Notes
Combined dry food for fish SULFUR VIPAN, mg	0.3	-
Meat mix for freshwater fish, mg	0.1	prepared according to the recipe

The composition of the combined feed SERA VIPAN includes fish meal, wheat flour, brewer's yeast, calcium caseinate, gammarus, whole egg powder, mannanoligosaccharides (0.4%), fish liver oil (including 34% Omega fatty acids), spirulina, herbs, alfalfa, nettle, green sponge shellfish meal, seaweed, parsley, paprika, spinach, garlic, carrots. The chemical composition of feed: protein 46.2%, fats 8.9%, fiber 3.5%, humidity 6.7%, ash substances 11.9% [8].

The composition of the meat mixture includes beef heart (50%); cod, pollock, squid (20%); shrimp (1%); broccoli, spinach (10%); paprika for color.

The body length of the fish was measured visually. Reproductive qualities were studied at the end of the month, by counting the born fry for the period of experience. Experimental groups of fish were kept in an aquarium with a volume of 50 liters. The aquarium was equipped with a cleaning filter, an aerator, a lid with a lamp, and a water thermometer was placed on the wall. A heater was used to maintain a constant water temperature of "plus" 22-25 ℃.

The second stage of the experiment lasted 90 days. In feeding predatory fish with cichlases, swordtails were used as live food. The scheme of the experiment is presented in Table 2.

Table 2. The scheme of the 2nd stage experiment.

Group	Heads	Fish type	Feed conditions	Indicators studied
Control	6	Cichlazoma diamond	The main combined food, alternated with the meat mixture every other day	1. Appearance 2. Dynamics of growth 3. Reproducibility 4. Business case
Experimental	6	Cichlazoma diamond	The main combined food was alternated with live food (swordfish) every other day	

Two groups of carnivorous ornamental fish of the cichlid family of brilliant cichlases were formed for the experiment, 6 animals in each group [7]. Body length was 5-6 cm, live weight was from 60 to 75 g.

Cichlomas were not sexually mature, as they did not reach a size of 8-10 cm. The groups were placed in different aquariums with a volume of 200 liters, which were pre-equipped with the necessary equipment: a compressor, sprayer, heater, and decorated soil. A filter was used to clean the aquarium, a thermometer was attached to the wall to control the water temperature. The water temperature was within the "plus" 26–32 ℃.

For three months, the fish of the control group were given only combined feeds and a meat mixture for freshwater fish, alternating every other day. The fish of the experimental group were fed with balanced food and live food (swordfish) weighing 0.75 g per cichlazoma. Compound feed and live food alternated every other day. Table 3 shows the feed consumption per day.

Table 3. Feed consumption.

Feed type	Feed amount (g/head per day)	
	Group	
	control	experimental
Combined dry food SULFUR Cichlid Stix	0.8	0.8
Combined dry food for fish Sulfur CichlidredXL	0.7	-
Meat mix for freshwater fish*	0.1	-
Livefood (swordtails)	-	0.75
Note: * Meat mix for freshwater fish prepared according to the recipe.		

The composition of the combined dry fish food SULFUR Cichlid Stix includes fishmeal; corn starch; wheat gluten flour; Wheat flour; wheat germ (5%); Brewer's yeast; fish oil (including 49% Omega fatty acids); gammarus flour; mannanoligosaccharides (0.4%); green mussels; algae hematococcus; garlic. Chemical composition: vegetable fibers make up 2%, fats 5.10%, ash substances 6.90%, humidity 7.50%, protein 38.20%. In addition, the feed contains carotene, which significantly improves the color of cichlids, making it brighter and more saturated.

The composition of the combined dry food for fish Sulfur Cichlid Red XL includes fish meal (40%), corn starch, wheat flour, wheat gluten, wheat germ, brewer's yeast, spirulina, fish oil (including 49% Omega fatty acids), hematococcus algae (0.5%), krill, mannanoligosaccharides (0.4%), vegetable raw materials, alfalfa, nettle, parsley, green mussels, seaweed, paprika, spinach, carrots, garlic. Chemical composition: protein 42.0%, fats 8.5%, fiber 2.8%, humidity 5.0%, ash substances 6.9% [8]. The meat mixture was used in the same composition as in the experiment of the first stage.

The following changes in appearance were observed. Body length was determined visually. Reproductive qualities were studied at the end of the experiment, the onset of spawning. The economic justification took into account the difference in feed prices. The results obtained were processed on the basis of generally accepted statistical methods by E.K. Merkurieva (1970) using the MS Excel software package, the reliability of the indicators was assessed according to Student [9].

3 Research results

Research results of the 1st stage of the experiment were as follows. At the end of the month, the body length and reproductive qualities of organic food objects of both groups were studied. Table 4 presents a comparative description of guppies and swordtails.

Table 4. Comparative characteristics of guppies and swordtails.

Indicator	guppies	swordtails
Size, cm	4.22(to 5)±0.14	7.55(7-8) ±0.07***
Duration of pregnancy, days	31.1(13-45)±2.34	40.15(30-50) ±1.59**
Number of fry, heads	73.9 (to 100)±3.61	177.35(to 200) ±4.77***
Note. * P>0.95; **P>0.99; ***P>0.999 in relation to the control group here and below.		

According to the results of the experiment we came to the conclusion that when comparing, a significant increase in all the studied indicators in swordtails was established, compared with guppies. Under the same conditions of keeping and feeding, swordtails give offspring more than guppies almost twice, that is, 100 fry more (P> 0.99). After studying the life expectancy, puberty and body size of both groups, they came to the conclusion that swordtails, rather than guppies, are more suitable for growing predatory ornamental fish as an organic object, in addition, their life expectancy is 2 years longer, puberty occurs by 1 week before.

Results of the second stage of research. In the aquarium with diamond cichlazoma of the experimental group, changes were traced in external, productive and reproductive qualities. The spawning season has begun. Table 5 presents the results of studies of fish from the control and experimental groups.

Table 5. The results of studies with cichlase.

Indicator	Group	
	Control	Experimental
Body weight, g,	-	-
month:	65±0.88	65±0.88
1	70±0.53	73±0.53***
2	74±1.58	80±1.08**
3		
Appearance, month	-	-
1	without changes	without changes
2	without changes	change in body color to a brighter one
3	redness of the gills	without changes

Appearance, month	-	-
1	No	No
2	No	No
3	No	spawning has begun

As a result of the study, it was noted that the diamond cichlasomes of the experimental group had a significantly greater body weight in the second month of the experiment - by 3 g (P> 0.999), and in the third month - by 6 g (P> 0.99), compared with the control cichlomas groups. The body color of the fish of the experimental group became brighter in the second month of research, which is associated with the content of carotene in the feed. The interaction of high-carotene food and live food significantly improved the color of the cichlids, making it brighter and more saturated. At the end of the third month cichlazomas of the control group experienced minor changes in body weight, it increased by 9 g compared with the weight at the beginning of the experiment. In addition, the appearance has changed: the color of the gills has become more red, which was due to the increase or decrease in nitrites and nitrates in the water, associated with the presence of rotting waste. Since the remains of food were deposited in the soil and provoked the process of decay.

As a result of research, it was noted that fish with an unequal diet developed differently. Growing and using swordtails as food for predatory cichlases is not expensive. For one spawning, a fish can give birth to about 200 fry, and thereby feed other predatory fish, providing their diet with a high content of complete protein, for offspring.

Economic substantiation of the results is as follows. Feed consumption for 90 days for the entire population of cichlase fish is presented in Table 6.

Table 6. Feed consumption for 90 days, g for all livestock cichlases.

Feed	**Group**	
	Control	**Experimental**
Combined dry food for fish SULFUR Cichlid Stix	144	216
Combined dry food for fish Sulfur Cichlid red	126	-
Meat mix for freshwater fish	18	-
Live food (swordtails)	-	202.5

Analyzing table 7, we can conclude that live food (swordfish) is consumed less by 301.5 g than food that is purchased for feeding fish.

Feed costs for 90 days are shown in Table 7.

Table 7. Feed costs for 90 days, rubles.

Feed	**Group**	
	Control	**Control**
Combined dry food for fish SULFUR Cichlid Stix	460.8	691.2
Combined dry food for fish Sulfur Cichlid red	453.6	-
Meat mix for freshwater fish	9	-
Live food (swordtails)	-	121.5
Total	923.4	812.7

Analyzing table 8, we can conclude that the cost of growing fish in the control group amounted to 923.4 rubles, which is 110.7 rubles more than when growing with cizlase of the experimental group. Thus, rearing ornamental fish on organic food items is economically beneficial for the zoo.

4 Conclusion

When comparing guppies and swordtails, which were used as live food for diamond cichlases, it was concluded that swordtails give offspring more than guppies per 100 fry, life expectancy is 2 years longer, puberty occurs earlier by 1 week. When feeding the diamond cichlazomas of the swordsmen in the amount of 0.75 g / head per day in addition to the combined dry food, the predatory fish of the experimental group had a body weight more by 6 g, compared with the cichlazomas of the control group, which, in addition to the compound feed, received a meat mixture for freshwater fish. The color of the body of the fish of the experimental group in the second month of research became brighter, this was caused by the interaction of food with a high content of carotene and live food, spawning began. In the fish of the control group, reddening of the gills occurred due to rotting food residues in the bottom. Thus, in order to increase the weight, improve the body color of fish, their reproductive abilities, live food with a high content of complete protein should be present in the diet. The economic calculation of the conducted studies showed that the cultivation of ornamental predatory fish on organic food objects is economically beneficial for the park.

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