

The Study of Different Foods on Spawning Efficiency of Siamese Fighting Fish (Species: *Betta splendens*, Family: Belontiidae)

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Abstract The effects of five different foods including: Blood worms, Artemia cysts, Artemia mass powder, Gammarus mass powder and ordinary commercial food were studied on Siamese fighting fish (*Betta splendens*) propagation efficiency during thirty days in a totally randomize design with 4 repeats. Experimental plots had been consisted of twenty 30×30×40 cm aquaria which a pair of male and female brood stocks was introduced to each one. Males and females were separated in each plot by a glass plate for 15 days in order to be prepared for spawning. The results of the experiment showed no significant ($p>0.05$) differences on spawned ova, ova diameter, and hatched ova among treatments. However, comparison of averages of referring factors showed that spawned ova, hatched ova, and ova diameter were better in those brood stocks that had been fed on Blood worm, whilst ,Ordinary commercial food treatment had resulted the weakest averages among dietary treatments.

Keywords Artemia cysts, Artemia mass, Blood worm, Gammarus mass, Siamese fighting fish (*Betta splendens*)

1. Introduction

The Siamese fighting fish (*Betta splendens*, /βɛ tɛ/) also known as betta, is a popular species of freshwater ornamental fish. *B. splendens* usually grow to an overall length of about 3 inches, including fins. Although known for their brilliant colors and large, flowing fins, the natural coloration of *B. splendens* is a dull green and brown, and the fins of wild specimens are relatively short. Brilliantly colored and longer finned varieties (i.e. Veiltail; Delta; Superdelta; and Halfmoon) have been developed through selective breeding. Properly kept and fed a correct diet, *B. Splendens* lives approximately 2–4 years in captivity but 5 is not uncommon. It is possible for them to live up to 10 years in rare cases. *Betta* Species also prefer a warmer water climate than other tropical fish - around 25-30 Degrees Celsius. (77-86 Degrees Fahrenheit) *Betta* fish have an organ known as the labyrinth organ which allows them to breathe air at the water's surface. It is often wrongly thought that this organ allows *Betta* fish to be kept in unmaintained aquaria. This is a misconception as poor water quality makes all tropical fish, including *Betta splendens* more susceptible to diseases such as fin rot.

Scientific classification	
Kingdom:	Animalia
Phylum:	Chordata
Class:	Actinopterygii
Order:	Perciformes
Suborder:	Anabantoides
Family:	Belontiidae-Ospheronemidae
Genus:	<i>Betta</i>
Species:	<i>B. splendens</i>
Regan, 1910	

The siamese fighting fish, it is very interested in for researchers. After some times, some of these persons think about reproduction these fishes. But unfortunately, this effort doesn't consist all the biological aspects and doesn't approach success and the output is not noticeable. (Arjini, 2006) Therefore, it is necessary to inform these people about living area conditions, preparation of spawning, mate finding, spawning time, hatching time and etc. Of course, there were previous studies about these fishes. For example, they could live in glass aquaria, but the proper dimensions of artificial living tanks are 24 × 12 × 12 (cm). (Terceira, 2000) In different articles were reported about nourish of Siamese fish, and their favorite foods, but some researchers believe that live foods, are the best food for the species. (Parnell, 2006) This research shows the effect of food as a special factor of increasing this fish, to answering to some questions

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about this subject. The Major purpose is to review current food items in growing of ornamental fishes on spawning of siamese fighting fish.

Geographical Dispersion:

Siamese fighting fish live in Southeast Asia and in areas where they have been accidentally released, such as Florida, in the United States. The wild Siamese Fighting fish can be found swimming amongst the inland waters of the Orient. It is native to Thailand, but can be found worldwide in pet stores as a domesticated fish. (Hargrove 1999)

Diet:

Siamese fighting fish have upturned mouths and are primarily carnivorous surface feeders, although some vegetable matter may be eaten. In the wild, they feed on zooplankton, crustaceans, the larvae of mosquitoes and other water bound insect larvae. Typically, commercial betta pellets are a combination of mashed shrimp meal, wheat flour, fish meal, brine shrimp, bloodworms, and vitamins. These fish will also eat live or frozen bloodworms, mosquito larvae, brine shrimp, daphnia, small freshwater shrimp, and small fishes. Hatching brine shrimp is a popular method used by many in the aquarium hobby to obtain live food for their Betta fish. Brine shrimp are the easiest live fish food to procure, hatch and cultivate and are particularly nutritious when the nauplii are in their early stages. Some aquarium fish are reluctant to accept dried or flake foods therefore live food is occasionally necessary.

Behavior:

The species' natural habitat is quiet shallow freshwater ponds with muddy bottom or flooded rice paddy fields. (Jaroensutasinee *et al.* 2000) they can breathe oxygen from the surface (due to their labyrinth organ), which enables the species to survive in low oxygen waters. (Foberg. 2003). Because of these, Betta to place in Labyrinth fish class. during the dry season, most Bettas are able to bury themselves in the bottom of their dried up habitat. There, they can live in moist cavities until water once again fills the depression during a rainy period. The fish can survive even if thick, clay mud is all that is left of the water. They do not survive total drying out of the bottom. (Vierke 1988) A well-known behavioral characteristic of the Betta is fighting. Male Bettas, more commonly than females, instinctively

fight with one another to defend their territory. In the Orient, the fish's animosity towards its own kind is capitalized upon through the medium of staged fights. Fighting fish have been bred for competitive fighting for centuries. Considerable sums of money are exchanged in wagers on these fights, which are illegal in the United States. (Ostrow 1989) Wild fighting fish rarely keep up their fights for more than 15 minutes, unlike the cultivated varieties which are considered poor if they fight for less than an hour. (Rodgers 1990) In reproduction, the Bettas have their own choreographed dance. When the female is finally ready to spawn, she approaches the male under the nest, swimming towards him in an oblique, head-down position with her fins closed against her body. This approach seems to signal the male that she is ready to mate, and he approaches her more gently than his previously aggressive displays.

Reproduction:

Mating begins with the male Betta building a nest of bubbles. To build this nest, the male swims to the surface, takes a gulp of air and spits out a mucus-coated air bubble. He then quickly takes another bubble of air and releases it near the first one. This process continues for hours with occasional breaks for food or to court the female. After awhile, the nest begins to take on a defiant shape. However, the shape and size varies. Once the nest is nearly complete, an extremely intense and often rough courtship begins. The male very aggressively pursues the female, attempting to entice her under the nest. In his efforts to bring her to the nest, he can be quite brutal if she doesn't willingly respond. More often than not, by the time the first spawning embrace begins, the female's fins are badly torn and she may even be missing some scales. After spawning has occurred, the male then guards the nest, taking care of the eggs until the young hatch 24 to 48 hours later, depending upon the temperature of the water. The young Bettas don't begin to show very much color or fin shape until they are about three months old. At about this time, males begin to fight with one another. It is also quite easy to sex Bettas around this age, as the males are usually more brightly colored and have longer fins than the females. The fish reaches sexual maturity around five months. (Ostrow 1989)



Figure 1. The Male (left) and the Female (right) Siamese fighting fish

Table (1). The important component of different food treatments

moisture	ash	Crud fiber	Crud fat	Crud protein	Type of treatments
6.5%	10%	3.5%	5%	65%	blood worm (Hikari company)
7%	5%	6.5%	8%	62%	Artemia cyst (urmiana) (Hoseinii · 2002)
5%	14%	3.46%	9.4%	46.36%	Artemia mass (urmiana) (Fazelii·2005)
8%	30.49%	9%	4.14%	42.43%	Gammarus mass (Caspiansea) (Mirzajanii·1987)
9%	10%	7%	6%	38%	commercial food (Nirooza company)

The main aim of the study:

The aim of this study is to obtain basic knowledge about possibility to increase the amount of spawning of brood's fighting fish and the most production of larva.

2. Materials and Methods**Experimental conditions and feeding strategy**

To perform this experiment, there are 5 food items that include: Blood worms, Artemia cysts, Artemia mass powder, Gammarus mass powder and ordinary commercial food have been chosen with 4 repetitions for each of them.

There are 20 aquaria with 40 × 30 × 30 (cm) with 18 liters water in each aquarium (15 cm height). At all of the time of this experiment, parameters for all of the treatments was conducted:

PH: 7-7/5

The air temperature: 30–35°C

The water temperature: 26-28°C

Total hardness: 108 mg/lit

Dissolved oxygen : 6 mg/lit

Inner rims of aquaria and other equipments in them such as aerators, etc.... were disinfected with salt without iodine. For disinfecting the fishes before introduce them to the aquaria, we used a bath solution of Acrofelavin 5% for 5 minutes. Then introduce a pair of healthy fish to any tentative parts. After that the fish were not fed for 24 hours. Then a glass screen was put between male and female fish in each aquarium and fish were fed, according to the respective diet, for a month two meals per day (at 9:00 am and 6:00 pm). Food was provided as 3% of fish biomass per day (Dick, 2004).

Fish breeding and data collection

When a male fish started to make a bubbling nest, at first a piece of thick plastic with an area about 10cm² was put into each male holding tank. So the male fish made a bubbling nest underneath. When these bubbles 500 numbers, female fish was allowed to be with the male by removing the glass

screen. About 24 hours after paring the fishes, the male finished the nest, then invited the female for spawning. At this time the female was bred (about 5-10) ova per patch that was immediately fertilized by the male. When the male saw the minute ova, collected all of them from his mouth and took them on top of water and put them between bubbles. A 3-5 minutes breeding dance was done. The spawning was continued about 3 hours. After 1 or 2 hours of spawning, in order to prevent to female fish harm, it was moved to another tank immediately. In all of the incubation time, temperature of the water was fixed at about 27 °C. The temperature was controlled by a digital thermometer (VIPRO, made in China) with 0.1 °C minuteness. The diameter of ova was measured by digital micrometer (Leitz, model 621, made in Germany). For this purpose, 10 ova of each pair of breeder were selected randomly and the diameter of them was estimated. This experiment was done in a private farm with annual capacity production of 50000 fish per year. Three to four days after spawning, all of the fertilized ova were hatched.

Statistical analysis

All the collected data such as: number of ova, number of larva and etc..obtained from aquaria have been recorded in specific tables. after performing experiments and gathering information, in order to determinate significant differences between treatments was performed one way variance analysis of data (ANOVA) and also for drawing the graphs was used Excel software. Furthermore to determinate of the most suitable food in the experiment. We used DUNCAN's test to comparing averages and for analyzing the variance and comparing the averages was used MSTST-C software.

3. Results

The range of brood fish's length was between 4-6 cm and their weight were between 2.5 – 4 gr. The average of ova diameter was about 1 millimeter. In the table (1) obtained results such as: Spawning time, Number of ova and larva and Percent of Survival rate in any treatment have been showed in average mode.

Table (1). Comparison between the results of Siamese fighting fish in different food treatments. (Numbers are average)

Percent of Survival rate	Number of larva	Number of ova	Spawning time (hours)	Type of treatments
92.9±4.554	219±24.253	235±20.155	192 ±19.595	Treatment 1 (blood worm)
90.86±1.757	186±12.556	205±15.628	264±43.817	Treatment 2 (Artemia mass)
93.6±5.162	203±26.839	212±29.859	240 ±64.999	Treatment 3 (Artemia cyst)
92.9±3.459	185±18.083	199±20.139	264 ±60.398	Treatment 4 (Gammarus mass)
92.42±1.771	177±15.895	191±14.361	312±54	Treatment 5 (commercial food)

Variance analysis did not show any significant ($P < 0.05$) difference between consideration factors during the experiment. But the result of Duncan's test of several factors in 30 days period (whole the period of experiment) in order to introducing the most suitable effective food treatment in our factors have been reviewed. During studying the ranking of each treatment upon the factors have been defined in which (A) in considered as the first rank and (C) is the last. considering values to the ranks are only numerical and are in the way below:

$$A > AB > B > BC > C$$

In this experiment the treatment which causes the shortest time of spawning and the largest amount of ova and larva was blood worm and scores rank was (A). in other side the treatment which causes the longest time of spawning and the shortest amount of ova and larva was ordinary food available in the market which will be placed in rank (C).

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4. Discussion

Siamese fighting fish are of great commercial value to the aquarium fish industry. They constitute one of the most common and popular fishes found in pet stores across the United States (Axelrod et al, 1971). Siamese fighting fish are omnivorous as evidenced by aquarium specimens which will readily take most food provided, including processed dry fish food as well as live invertebrates. (Axelrod et al, 1971., Sterba, 1983., Sakurai et al, 1992) they eat different foods. These fishes usually find food among plants on top of the water but when they are hungry, benthic little fishes are their food. The food of this fish is zooplanktons, larva and insect ova (Arjini, 2000). According to this research, this fish can be fed with dry live foods or fresh foods that adapted to the size of their mouth. Also Parnell, 2006 reported that the live food is the best food for siamese fighting fishes.

B. Hunt in 2003 showed that favorite food for this fish is alive larvae of water insects and he believed the best food for

siamese fighting fish in the aquarium is freezing blood worms. Terceira in 2000 has proposed suitable dimension of synthetic habitat for siamese fish is 24 × 12 × 12cm, but in this study these dimensions are 40 × 30 × 30cm. Sharpe in 2007 believes that, the suitable temperature for this fish is 24-30 °C. Sogeke in 2005 confirmed this temperature and said the best temperature is between 26-28 °C. In this experiment, according to Sharpe & Sogeke ideas, the temperature was 27 °C.

In present study, the range of brood fish's length was between 4-6 cm. Jaroensutasinee et al. in 2000 and Simpson in 1968 believed that wild living fighting fish are in general smaller with a length of 2.5-3cm compared to the domesticated ones which have a length of 3 - 5 cm.

Aquarium specimens can grow to 100 mm, although 65 mm seems more typical (Axelrod et al., 1971; Stebra., 1983). Stebra (1983) reported a maximum length of 50 mm for wild specimens over their native range. Sterba in 1983., Sakurai et al, 1992 about reproduction and fecundity of Siamese fish reported that, Males build bubble nests by blowing bubbles around a floating leaf base. Females spawn under the nest, where the male waits to fertilize the eggs. Typically 400-500 eggs are spawned. (Stebra, 1983)

So it is observed, Ft in time of fish spawning is 2.069, in number of counted eggs is 2.640, in number of counted larva is 2.847 and at Percent of survival rate is 0.344. It is shown that there are not any significant different by 5 type treatments in mentioned indicators. But, Dan can test showed that the results of a study about the effects of different factors on some indicators during 30 days (total period of the experiment) can introduce the best food treatment, and type of treatment effects on the time spawning of siamese fish, the number of ova and larva. In all of the factors, such as number of ova, larva, ... blood worm has the highest grade (A) and commercial food has the lowest grade (C) Considering of results in variance analysis and Dan can test showed the percent of unfertilized eggs were changed between 5% - 10%. Finally, efficiency of spawning were more than 90%.

So it was seen, in all of factors the best results were in blood worm, because the percent of protein in blood worm is high. Protein is a key element required for health and growth in all types of fish. Herbivores need 15 to 30 percent protein in their diet, while carnivores need at least 45 percent protein.

for vigorous health growth, young fish require 50 percent in their diets (Parnell. 2006). So, these fishes like this food more than the others. Therefore the arrangement of foods according these values are: blood worm, Artemia cyst, Artemia mass, Gammarus mass, commercial food. Of course, by attention to the effect of each treatment of 1 and 3, combination of 2 treatments, blood worm & Artemia cyst, offered as the best food. Also, because of all of the food treatments had the results better than commercial food, so it suggests that the compound of this food was changed or you can add to one of these foods to ordinary Betta's food in the market.

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