A review of the treatment and immunization ornamental fish and cultured fish from common bacterial diseases.

Souad Salah ADEM \ Benghazi University, Science Faculty, zoology department Taucheira Campus, Taucheira- Libya /

Fariha Mahmoud alamin / Benghazi University, Science Faculty, zoology department/
A review of the treatment and immunization ornamental fish and cultured fish from common bacterial diseases.

Abstract:
This review aims to clarify and define bacterial diseases that affect ornamental fish, cultured fish and ways to treat and prevent them to decrease the risk of infection. In aquarium and ponds there are two types of bacteria classified as good bacteria and bad bacteria, the good bacteria (Nitrosomonas and Nitrobacter) maintains the nitrogen cycle of the aquarium, while the bad bacteria causes many diseases which lead to dying in aquarium fish if not treated early. Bacterial diseases are often secondary infection to an imbalance in the environmental conditions such as poor water quality and improper handling of aquarium. The Major aquarium fish bacterial pathogens are: Edwardsiella sp., Aeromonas complex., Flexibacter, sp., Pseudomonas sp., Vibrio sp and Mycobacteria sp .

Bacterial diseases treated with antibiotics, preferably in quarantine. Vaccinations are still uncommon for aquarium fish, but common used in fish farms .

.Key words: Ornamental fish, Cultured fish, Infection, Bad bacteria, Good bacteria, Vaccine
Introduction:

Fish, like other animals, get diseases as a result of infection with bacteria (54.9%), viruses (22.6%), fungi (3.1%), worms (19.4%) [1] (Figure 1) or by changes in the environment in which they live, like change in temperature, lighting or water quality. Fish hobbyists and breeders, whether to decoration or trade, seek to raise healthy fish free of parasites and their diseases. Parasitic infestation tends to decrease the growth rate resulting in stunting of the fish growth [2]. In this study, we will highlight the bacterial diseases that affect aquarium fish.

Infestation of bacterial disease is common in dense populations of cultured fish or aquarium fish. Susceptibility to such infection frequently is associated with poor water quality, organic loading of the aquatic environment, handling and transport of fish, marked temperature changes, hypoxia, or other stressful conditions. Most bacterial pathogens of fish are aerobic, gram-negative rods [3]. Diagnosis is by isolation of the organism in pure culture from infected tissues and identification of the bacterial agent. Sensitivity testing before antibiotic use is recommended [4].

Typically there are two bacteria in aquarium classified as either 'good' bacteria or 'bad' bacteria. The good bacteria consist of the ones that responsible for make up the biological filter. These bacteria break down ammonia and nitrate so that it can be removed from the water. Without good bacteria most life would not be able to exist [5]. The bad bacteria are often bacteria that are normally present but don't cause problems until the fish is harmed, stressed or suffering from another disease so bacterial infections are often secondary to a previous parasitic or worm infestation [6]. These bad bacteria exploit the undermined creature's debilitated resistant framework and reproduce extremely quickly, creating the resultant illnesses and problems.
The Major aquarium fish bacterial pathogens are:

**Edwardsiella sp** which is consists of five species;

Edwardsiella tarda, Edwardsiella ictaluri, Edwardsiella hoshinae, Edwardsiella piscicida and Edwardsiella anguillarum. the genus Edwardsiella tarda, reported as a pathogen of aquatic animals and humans [7] (figure 2,a).

Aeromonas complex: Motile Aeromonas include three species: Aeromonas hydrophila, Aeromonascaviae and Aeromonas sobria [8] Aeromonas hydrophila is considered as a persuasive pathogen that causes mortalities in tilapia and other freshwater fish [9] (figure 2,b).

**Flexibacter sp**: Most of them infect marine fish and the most isolated and described are *Flexibacter maritimus*, [10], *Flexibacter ovolyticus* [11],*Chryseabaterium scophthalmum*.(figure 2,b ).

**Pseudomonas sp**: A big number of Pseudomonas species causing disease for humans, animals and aquatic organisms [12] in spite of the fact that Pseudomonas spp. have been described as opportunistic pathogens, many species have also been identified as the primary pathogen of several diseases in farmed fish, including *Pseudomonas aeruginosa*, *Pseudomonas anguilliseptica*, *Pseudomonas baetica*, *Pseudomonas chlororaphis*, *Pseudomonas fluorescens*, *Pseudomonas koreensis*, *Pseudomonas luteola*, *Pseudomonas plecoglossicida*, *Pseudomonas pseudoalcaligenes* and *Pseudomonas putida* [13]. Recently, a new species, named *Pseudomonas tractae*, was isolated from rainbow trout kidney [14] .(figure 2,d).

**Vibrio sp**: Over 100 species of Vibrio. It has been reported mainly to be associated with different types of estuaries or other aquatic marine habitats [15]. Red drum (S. ocellatus) mortality in recent years has been associated with streptococcal infections. [16]. (figure 2,d).
Mycobacteria sp: There are four species that are commonly associated with outbreaks: Mycobacterium marinum, the most common of these fish mycobacterial pathogens, Mycobacterium fortuitum, Mycobacterium gordonae, and Mycobacterium chelonae. The host range of these bacteria is wide: they are zoonotic and a large number of fish infections have been reported. [17].

Figure 2:a External signs of Catla infected with *Edwardsiella tarda*.

Figure 2:b Hemorrhages in skin in fish infected by *Aeromonas salmonicida*.
Figure 2: e shows Gill lesions in a shubunkin (Carassius auratus) (operculum removed) caused by Flexibacter columnaris.

Figure 2: d Deep lesions on the skin of Trachurus mediterraneus caused by Vibrio spp. and Pseudoalteromonas haloplanktis.

Figure 2: e External lesions caused by mycobacteriosis on a striped bass from Chesapeake Bay.

The most aquarium fish bacterial pathogens are summarized in Table 1. Symptoms of bacterial infection:
Symptoms vary according to the bacteria that causes disease but the overall of these most important:

lost its appetite.

Weight loss.

Lying on the bottom of the aquarium.

loss of balance.

Discoloration.

Rapid breathing with gasping at the surface

Redness or open wounds on the skin.

Ulcers and shedding of crusts.

A white film or “fungus” looking growth can denote a bacterial infection.

Frayed fins / fin & tail rot

Cloudy and bulging eyes, sometimes loss of vision.

Abdominal dropsy.

The protrusion of part of the inflamed intestine from the opening of the complex.

Bacteriology sampling:

Fish displaying the previously mentioned symptoms are gathered and sampled for testing. The bacterial swab is taken, when numerous lesions are found, An incision then made with a sterile scalpel across the lesion, cutting to the outside of the lesion into healthy flesh. A swab is then drawn across the resultant cut, from the inside of the lesion out into healthy tissue, rolling the head of the swab. The swab is then placed in a sterile container and transplanted by swabbing on Petri dishes containing an appropriate culture medium [18]
Table 1: The most common types of bacteria that infect aquarium fish:

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Type of bacteria</th>
<th>Target species</th>
<th>Common name</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edwardsiella ictaluri</td>
<td>Gram negative</td>
<td>Freshwater fish</td>
<td>Enteric septecemia of Catfish ESC; &quot;Hole in the Head Disease&quot;* Danio; green knife fish; walking catfish</td>
<td>Gastroenteritis septecemia ascites petechial hemorrhages brain abscesses aberrant swimming</td>
</tr>
<tr>
<td>Flexibacter columnaris</td>
<td>Gram negative</td>
<td>freshwater, marine fish occasionally</td>
<td>Columnaris disease worldwide cottonmouth disease tail rot; Mouth fungus.</td>
<td>Cottonmouth skin lesions saddle back fin &amp; tail rot</td>
</tr>
<tr>
<td>Aeromonas hydrophila complex</td>
<td>Gram negative</td>
<td>freshwater, marine &amp; brackish fish</td>
<td>Bacterial hemorrhagic septecemia;</td>
<td>hemorrhages in skin exophthalmia ascites ulcers</td>
</tr>
<tr>
<td>Aeromonas salmonicida with A hydrophila</td>
<td>Gram negative</td>
<td>freshwater and marine fish</td>
<td>Ulcer disease of goldfish (Furunculosis)</td>
<td>Ulcers Hemorrhages injected fins</td>
</tr>
<tr>
<td>Pseudomonas fluorescens</td>
<td>Gram negative</td>
<td>fresh; brackish and marine fish</td>
<td>Pseudomonas septicemia.</td>
<td>hemorrhagic septecemia ascites; hemorrhages exophthalmia; ulcers</td>
</tr>
<tr>
<td>Vibrio anguillarum</td>
<td>Gram negative</td>
<td>freshwater and marine fish</td>
<td>vibriosis; worldwide mostly marine and estuarine env.</td>
<td>hemorrhagic septicemia exophthalmia; ulcers</td>
</tr>
</tbody>
</table>
Mycobacterium fortuitum & M. marinum, Gram-positive
Freshwater fish
Mycobacteriosis
skin lesions;
wasting exophthalmia;
weakness
color changes

Treatment:
Antibiotics are only when fish get sick from microbes, not environmental changes effectively treat bacterial infections that fish cannot resist. Antibacterial Medicines from your local pet supply store are often not effective at all. If the type of bacteria is not Known, then a wide spectrum antibiotic is usually used.

The major routes of treatments:

Injection: The injection is the most direct and successful way to get antibiotics into the bloodstream. This method is very intensive and impractical for commercially farmed fish. However, injection is the best method for small numbers of fish, important fish or aquarium fish. Injection sites include the intraperitoneal cavity and the intramuscular sites [19].

Mixed in food: the appropriate dose of antibiotics is mixed with the food provided to the farmed or ornamental for the prescribed number of days and this is the most widely used and most-cost effective method. When taking oral antibiotics, we must ensure that all fish eat and make every effort not to catch bacterial disease early, because the infected fish will stop eating and thus the diseased fish that no longer eat will contribute to the death of the fish [20].

Bath treatments: Although bath treatments are a well-known way to manage antibiotics, much more medication is required compared to oral therapies or injections, to get the desired result. Even a substantial concentration of antibiotic in the water is frequently insufficient to ensure that the fish will receive enough of it for the treatment to be successful. At the same time, too much antibiotic in the water can make it more likely that water-borne bacteria will become resistant to it. Additionally, between 70% and 100% of the water should be changed.
at the end of each daily treatment as well as before redoing in order to avoid poor water quality and any potential toxicity. Last but not least, bath treatments are not advised in aquarium systems or recirculating systems where the treated water will come into touch with the biological filter since the antibiotics may impede or kill the nitrifying bacteria in the biological filters. [21].

Table 2: Antibiotics used for bacterial disease

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Oral (food) Dose</th>
<th>Bath Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>1.2–3.6 grams/lb food per day for 10 days</td>
<td>Not suggested</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>150 mg/lb food per day for 10 days</td>
<td>Not suggested</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>1.5 grams/lb food per day for 10 days</td>
<td>Not suggested</td>
</tr>
<tr>
<td>Florfenicol (Aquaflo)</td>
<td>For a 1% Feeding Rate, 680 mg/lb for 10 days</td>
<td>Not suggested</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>45 mg/lb food per day for 10 days</td>
<td>Not suggested</td>
</tr>
<tr>
<td>Kanamycin</td>
<td>300 mg/lb food per day for 10 days</td>
<td>189-378 mg per gallon every 3 days for 3 treatments</td>
</tr>
<tr>
<td>Nalidixic Acid</td>
<td>300 mg/lb food</td>
<td>500mg per 10 gallons, repeat as</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Dose per day for 7–10 days</td>
<td>Needed</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Neomycin</td>
<td>1.5 grams/lb food per day for 10 days</td>
<td>2.5 grams per 10 gallons every 3 days for up to 3 treatments</td>
</tr>
<tr>
<td>Nitrofurazone</td>
<td>1.12 grams/lb food per day for 10 days</td>
<td>189–756 mg per 10 gallons for 1 hour, repeat daily for 10 days OR 378 mg per 10 gallons for 6–12 hours, repeat daily for 10 days.</td>
</tr>
<tr>
<td>Oxolinic Acid</td>
<td>150 mg/lb food per day for 10 days</td>
<td>38 mg per 10 gallons for 24 hours, repeat as needed OR 95 mg per gallon for 15 minutes, repeat twice daily for 3 days</td>
</tr>
<tr>
<td>Oxytetracycline (Terramycin)</td>
<td>1.12 grams/lb food per day for 10 days</td>
<td>750–3,780 mg per 10 gallons for 6–12 hours, repeat daily for 10 days (dose will depend on hardness of water)</td>
</tr>
<tr>
<td>Romet B</td>
<td>Romet B</td>
<td>Not suggested</td>
</tr>
</tbody>
</table>

The FDA (Food and Drug Administration) has chosen to utilize administrative caution to keep items expected for the treatment of aquarium fish accessible.

**Erythromycin:** The Streptococcus species are among the gram-positive bacteria that erythromycin works best against.

The gram-positive bacteria like Streptococcus species are most susceptible to the penicillins, which include **penicillin, amoxicillin, and ampicillin;**

The usage of oxytetracycline under the brand name Terramycin, produced by Pfizer, is permitted by the FDA for the growth of salmonids, channel catfish, and lobsters. When taken
intravenously, the aminoglycosides, such as gentamicin, neomycin, kanamycin, and amikacin, are quite effective for treating infections caused by gram-negative bacteria.

**The quinolones, including nalidixic acid and oxolinic acid** are viewed as wide range antibiotics, like the tetracyclines, and they neutralize a wide variety of bacteria.

The FDA strictly limits the use of the nitrofurans by those who raise fish for human consumption, including nitrofurantoin, nitrofurazone, furanace, and furazolidone. However, they are frequently used in the ornamental fish trade. According to the FDA, nitrofurazone is expressly designated as "of significant regulatory concern" and is not permitted in any setting where animals are grown for food. [22].

**The sulfa drugs, including Romet**, are likewise viewed as broad-spectrum antibiotics. There are a wide range of sorts of sulfa drugs. Because of their abuse or overuse, which led to the development of numerous bacteria that are now resistant to them, the more prevalent sulfas are not quite as effective as they once were. Romet, among other potentiated sulfas, is still highly suited, nonetheless. [23].

Conservatism:

Maintaining a suitable habitat for your fish to dwell in, such as clean water.

Separating two fighting fish before injuries get too severe.

Using the right nutrition, soaking fish food in vitamin supplements, and consuming live foods, nori, and frozen meals high in protein (e.g. Selcon, Zoecon, Vita-chem). These will support the natural immune system of your fish.

Using a fish quarantine tank can keep parasites and other undesirables out of your fish, especially dangerous gram-negative bacteria. As a result, there will be less chance of a "secondary" bacterial infection developing while the fish's immune system is already weak from fighting worms and parasites.

Running an Ozone or UV sterilizer may be helpful in some circumstances because they will reduce the overall quantity of hazardous bacteria found in the water column.
Immunization of fish with vaccine.

Fish vaccines can be delivered the same way we immunize warm-blooded animals. Fish can be immunized by immersion in vaccine for a short period of time 30 seconds to 2 minutes. They can be immunized by injection, intramuscularly or intraperitoneally, and orally by mixing vaccines with feed either by top dressing or by incorporating into feed as an ingredient [24]. In the past, inactivated microorganisms that were combined with adjuvants and administered via immersion or injection have made up the majority of licensed fish vaccines. [25]. There have been many vaccines developed that significantly reduced the impact of bacterial and some viral diseases in fish [26]. Over 26 licensed fish vaccines are commercially available worldwide for use in a variety of fish species. The United States Department of Agriculture (USDA) has authorized the use of the majority of the vaccinations for a number of aquaculture species. [27].

Table 3: The most popular vaccines to immunize fish

<table>
<thead>
<tr>
<th>Vaccine Name</th>
<th>Disease</th>
<th>Vaccination Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renogen</td>
<td>Bacterial kidney disease</td>
<td>Injection</td>
</tr>
<tr>
<td>Aqua – vac ESC</td>
<td>Chanel catfish septicemia</td>
<td>Immersion</td>
</tr>
<tr>
<td>Aqua – vac Col</td>
<td>Columnaris disease</td>
<td>Immersion</td>
</tr>
<tr>
<td>Furogen Dip</td>
<td>Furunculosis</td>
<td>Injection</td>
</tr>
<tr>
<td>Lipogen Forte</td>
<td>Vibriosis</td>
<td>Injection</td>
</tr>
<tr>
<td>Fry vacc1</td>
<td>Columnaris Disease</td>
<td>Immersion</td>
</tr>
<tr>
<td>Vibrogen 2</td>
<td>Vibriosis</td>
<td>Immersion</td>
</tr>
<tr>
<td>Ermogen</td>
<td>Enteric Redmouth Disease</td>
<td>Immersion</td>
</tr>
<tr>
<td>Forte V II</td>
<td>Infection salmon – Furunclosis-Vibriosis-combo</td>
<td>Injection</td>
</tr>
</tbody>
</table>
Conclusion:

These are just a few of the most common bacterial infections that can infect fish. After reviewing the list of infections, it is extremely evident that most bacterial infections are caused by a few similar situations, and that following a few basic precautions can prevent a large portion of these infections. The precautions include keeping up excellent water quality at all times, rapidly eliminating any dead or infected fish from the tank, treating all diseased fish, never bringing infected or sick fish into your community tank, and preventing injuries from fighting or unsuitable habitat. If these basic guidelines are followed, bacterial infections will be an extremely uncommon event in your tank. A fish health specialist should be consulted to help with appropriate conclusion, to run culture and sensitivity tests, and to give the best information regarding dosages and treatment intervals.

Wrong utilization of any antibiotic can lead to the creation of resistant bacteria in a facility so fish vaccines are advantageous over antibiotics because they are regular organic materials that leave no residue in the product or environment, and therefore will not induce a resistant strain of the disease organism.
References


4- Wanda, C. Tankarium-(2021). Aquarium Bacteria: Good Bacteria & Bad Bacteria.


