# Medicated foods

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Oral medications are an excellent way to target internal diseases of fishes. Marine fish absorb aquarium water, so in certain cases, they "drink" enough medication from the water to effect a cure. However, freshwater fish actively export water from their tissues and do not take in aquarium water, so injectable or oral medications are really the only delivery system that works for them.

Years ago, there were a variety of commercially available medicated flake and pellet foods. Currently, there seems to be only one product on the market, so aquarists are faced with either forgoing medicated foods, or making their own.

Presently, many aquarists try to soak their fish food in medication and then feed that to their fish. The trouble is that this can never really work. Oral fish medications are always dosed on an "as fed basis", usually milligrams of medication per kilogram of fish biomass. In the case of soaking food in medication; the amount of medication per gram of food is unknown, as is the weight of the fish, and so is the amount of food being fed. With that many variables, a proper dose simply cannot be formulated.

One drawback to oral medication is that the fish must be healthy enough to be feeding properly. A fish that is too sick to feed, may need to be either injected with medication, or tube-fed (see section elsewhere). In tube-feeding, since you have the fish in hand, it can be directly weighed in order to calculate an accurate dose.

The typical formula for medicated food is:

### XX Milligrams of medication per Kilogram of fish mass in food, fed at 3% of the fish's weight per day

1) Select a medication and dose from the formulary below.
2) Estimate the weight of all of the fish to be treated
3) Prepare the medicated food – either gel diet, or dissolved with a solvent and sprayed on food
4) Feed at a rate of 3% of the fish's total body mass daily, or as indicated in the formulary

### Formulary (derived from Noga 2010, in turn from various other sources)

**Enrofloxacin (Baytril)** Active against *Aeromonas, Vibrio*. 10 mg/kg of body weight per day for ten days.

**Erythromycin** Useful in treating gram positive bacterial infections, notably kidney disease. 100 mg/kg of body weight per day for 21 days.

**Kanamycin** Broad spectrum activity against gram negative bacteria. 50 mg/kg body weight daily for five days.

**Magnesium sulfate** May inhibit gut protozoans such as *Hexamita, Spironucleus*. Add to gelatin recipe at a rate of 3%, feed daily for three days.

**Metronidazole (Flagyl)** Treats both intestinal flagellates and anaerobic bacteria. 100 mg/kg body weight daily for three days.

**Oxytetracycline** Active against a wide range of bacterial pathogens, including *Columnaris, Aeromonas, Pseudomonas*. Inactivated by seawater, best used orally, wide range of dosing. 83 mg/kg body weight daily for ten days.

**Panacur (Fenbendazole) Active** against nematodes in the digestive system. 50 mg/kg body weight weekly for two treatments. Do not use on bottom-dwelling fishes; darters, catfish, etc. Do not use on flashlight fish or pencilfish. Additional species may be found to react poorly to this medication. Affected fish will die post-treatment, despite water changes, over a period of days. Their mouths will be gaped open upon death.

**Praziquantel (Droncit)** Treats cestodes and Monogenean flukes. 50 mg/kg body weight every other day for three treatments.

## Recipe for general formula gelatin fish food

To make 1 kilogram (2.2 pounds) of food:

1) Dissolve 3 ounces, (3 packets) of unflavored gelatin in 300 ml of very hot water (160 degrees F.)

2) Blend together the following ingredients:

   100 grams of smelt or other white fish flesh

   50 g frozen mixed vegetables (or 20 grams of dried Nori algae for marine fish)

   50 g shrimp tails, peeled

   100 g small krill or mysid shrimp

   30 g flake fish food, freeze dried foods, etc.

   2 g *Spirulina* powder (optional)

   1000 mg ascorbic acid (optional)

   1 multi-vitamin tablet, crushed

   300 ml water

3) Once the gelatin has cooled to 110 F., fold the dissolved gelatin into the above mixture,

4) Fold in any additives, such as medications. Blend for 30 more seconds at low speed.

5) Pour mixture into ice cube trays. Place the trays into the freezer.

6) After about one hour, remove and cut each slightly hardened block in half, leaving the two pieces inside the tray.

7) Return to freezer for 6 or more hours. Remove blocks, and separate at the cut points. Return blocks to freezer for storage. The final product should probably not be kept longer than two months.

8) Mazuri, a subsidiary of Purina offers a line of powdered gelatin food pre-mixes to public aquariums. Different formulations are available (such as herbivore and carnivore varieties) and it is easy to add supplements to the mix such as HUFAs or vitamins. These mixes are much more convenient than making

your own food from scratch, and they have had the obvious benefit of having been formulated by nutritional experts.

**Solvent spray dosing**

If a particular drug can be dissolved in a solvent, that solution can then be sprayed onto a flake, freeze-dried or pellet food with good assurance that the drug will soak in and bind with the food when allowed to dry. Pure ethanol is a common solvent. In some cases, distilled water can be used. Simply calculate the amount of drug to be added to the food item and dissolve it in the least amount of solvent as possible. Spread the food item out of a tray and spray evenly with the solvent/drug mixture and allow to dry.

## Fish Mass determination

Many oral and injectable medications require that the fish's body mass be known prior to the proper administration of these compounds. Calculating an aquarium's carrying capacity, specimen feeding rate, or food supplement concentration also require that the fish's mass be determined prior to such computations.

The following text describes three potential methods for determining the mass of living fishes, including the benefits and drawbacks of each technique.

**1) Direct determination:**

Obtaining the actual mass of a living fish is often problematical. Some species cannot tolerate the handling required to obtain such measurements; the physical stress involved may actually cause the death of a delicate specimen. In other cases, the fish are simply not retrievable due to the intricate physical structure of their aquarium. In yet other situations, the labor involved in directly weighing a given fish is greater than the potential benefit that might be gained from obtaining the data. These three factors, sometimes in combination, often result in a revision of a preferred oral or injectable medication treatment regime to a possibly less effective, but more easily administered one such as a static bath. There are four basic methods to directly measure the mass of a living fish:

a) The fish can be captured, moved to a small holding container, and anesthetized with Metomidate at 4 to 8 mg/l (or another anesthetic such as MS-222 at an appropriate dose). The fish is then transferred to a clean weighing pan (covered with a soft wet substrate) and weighed. The time that the fish is removed from the water, (without supplemental life support) should be less than five minutes - inclusive of any medical procedures that might be required at the same time. All anesthetics pose an inherent risk to the subject, and cost factors, (including time) must also be evaluated.

b) A non-anesthetized fish can be captured, and moved to a small holding container with sufficient water, (One that has previously been measured or tared on the scale) and weighed. The weight of the container and the water can then be subtracted from the total, and the fish's mass be determined. The primary drawback to this method is that a scale that has a range wide enough to be tared with perhaps 9 kilograms of water plus the container, (roughly a full two gallon bucket) will not normally have sufficient accuracy to then be able to compute the mass of the fish it contains which might only weigh .5 kilograms.

Limiting the amount of water in which the fish is held will reduce this problem, but will subsequently increase the stress to which the fish is exposed.

c) A small non-anesthetized fish could be captured, and quickly placed directly on the weighing pan of a scale, and the weight measured. Movement of the fish will affect the results of such a measurement, and most aquarists would consider the stress to which the fish would be exposed to be unacceptable.

d) A rarely used method for fish mass determination is volumetric displacement. In theory, a fish can be placed in a container of water that has volumetric graduations. The displacement of the water after the fish has been added could be used to calculate its mass. Most fishes are neutrally buoyant in water, so the weight of the water displaced can be considered equal to the mass of the fish. In practice, an extremely narrow cylinder would be required in order to obtain an accurate vertical resolution of the water displaced after the fish was placed in the container.

For the two following mass estimation methods, the fish's length must be known: Holding a tape measure against the front of a tank as the fish swims nearby is perhaps the best means to determine its length. Taking an instant photograph of the fish alongside an object of known length is another possible method. The refraction of the water does not seem to affect these readings; as it does while SCUBA diving (where objects underwater appear 30% larger or 30% closer than they would in the air).

**2) Observational estimate:**

Using a fish's length alone, aquarists may sometimes attempt to estimate its mass. Typically, one needs a certain amount of data before attempting such an estimate; either anecdotal knowledge of the mass of similar fishes, or knowing the mass of comparable objects in terms of size and density. For example, an uncooked hamburger patty weighs about 110 grams. With a mental picture of this, the aquarist then estimates how many of these "hamburger patties" could be contained in the body of the fish. In practical use, without a sound frame of reference, observational estimates are often inaccurate to the point of being useless. Twelve aquarists were asked to estimate the mass of 6 fishes of known mass. Their estimates averaged 75% higher than the actual mass of the fishes. Not a single estimate was within 20% of that of a given specimen. Observational estimates are best used if one knows from previous experience, the mass of a same sized fish of an identical species derived from a previous direct weighing. Table one gives some examples of direct measured fish masses that aquarists might find helpful in refining their own observational estimates.

**3) Direct Comparison against a known data set:**

This is an improvement of the observational technique in which data previously compiled from fishes of similar length and body morphology is used to obtain a mass estimate of the specimen in question. Aquaculturists have long used this technique for commonly cultured species; for example, tables have been developed that show how many salmonid fry of a given size comprise a kilogram of biomass. Accuracy suffers when one attempts to estimate the mass of atypical fish, such as robust gravid females, or ill specimens that are in an emaciated condition. Nevertheless, such a database program can be used as an adjunct tool for the serious aquarist wishing to estimate the mass of a fish and avoid the inherent stress of direct weighing.

| **Common Name** | **Genus** | **Length CM** | **Weight Gr** |
|---|---|---|---|
| Damselfish | *Pomacentrus* | 2.2 | 0.5 |
| Yellowtail Blue Damsel | *Pomacentrus* | 2.2 | 0.5 |

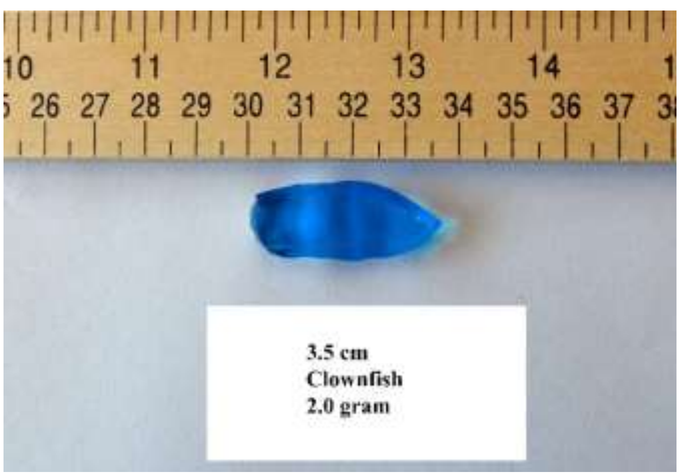
| | | | |
|---|---|---|---|
| Damselfish | *Pomacentrus* | 2.3 | 0.8 |
| Yellowtail Blue Damsel | *Pomacentrus* | 2.3 | 0.8 |
| Damselfish | *Pomacentrus* | 2.7 | 0.8 |
| Yellowtail Blue Damsel | *Pomacentrus* | 2.7 | 0.9 |
| Damselfish | *Pomacentrus* | 2.8 | 0.9 |
| Damselfish | *Pomacentrus* | 3.0 | 1.2 |
| Yellowtail Blue Damsel | *Pomacentrus* | 3.0 | 1.2 |
| Damselfish | *Pomacentrus* | 3.2 | 1.3 |
| Yellowtail Blue Damsel | *Pomacentrus* | 3.2 | 1.3 |
| Royal Gramma | *Gramma* | 3.8 | 2.4 |
| Humu Humu | *Rhinecanthus* | 3.9 | 3.0 |
| Lionfish | *Pterois* | 4.5 | 2.3 |
| Flashlight Fish | *Anomalops* | 5.5 | 2.4 |
| Lionfish | *Pterois* | 5.5 | 4.5 |
| Pakastani Butterfly Fish | *Chaetodon* | 5.5 | 8.0 |
| Pygmy Angelfish | *Centropyge* | 6.2 | 13.2 |
| Purple Anthias | *Anthias* | 6.5 | 5.5 |
| Achilles Tang | *Acanthurus* | 6.6 | 8.9 |
| Flying Gurnard | *Dactylopterus* | 6.8 | 4.9 |
| Rainford's | *Chaetodon* | 7.1 | 17.7 |
| Pipefish | *Syngnathus* | 8.0 | 2.0 |
| Yellow Tang | *Zebrasoma* | 8.6 | 25.0 |
| Butterflyfish | *Chaetodon* | 8.9 | 42.9 |
| Butterflyfish | *Chaetodon* | 8.9 | 42.9 |
| Rainford's | *Chaetodon* | 9.1 | 42.5 |
| Yellow Tang | *Zebrasoma* | 9.6 | 38.4 |
| Butterfly Fish | *Chaetodon* | 11.0 | 31.5 |
| Cardinalfish | *Apogon* | 11.2 | 30.0 |
| Cardinalfish | *Apogon* | 11.4 | 28.0 |
| Personifer Angel | *Chaetodontoplus* | 11.5 | 70.9 |
| Duboulayi Angelfish | *Chaetodontoplus* | 11.7 | 92.1 |
| Pipefish | *Syngnathus* | 12.0 | 3.5 |
| Pinecone Fish | *Monocentris* | 12.1 | 81.0 |
| Angelfish | *Euxiphipops* | 12.7 | 65.0 |
| Porcupine Fish | *Diodon* | 13.1 | 120.6 |
| Seahorse | *Hippocampus* | 13.2 | 4.8 |
| Cardinalfish | *Apogon* | 13.5 | 39.0 |
| Hepatus Tang | *Paracanthurus* | 13.5 | 41.6 |
| Soldierfish | *Myripristis* | 13.7 | 50.0 |
| Powder Blue Tang | *Acanthurus* | 13.8 | 51.0 |
| Angelfish | *Pomacanthus* | 14.0 | 116.2 |
| Cardinalfish | *Apogon* | 14.5 | 87.0 |
| Hepatus Tang | *Paracanthurus* | 14.5 | 63.0 |

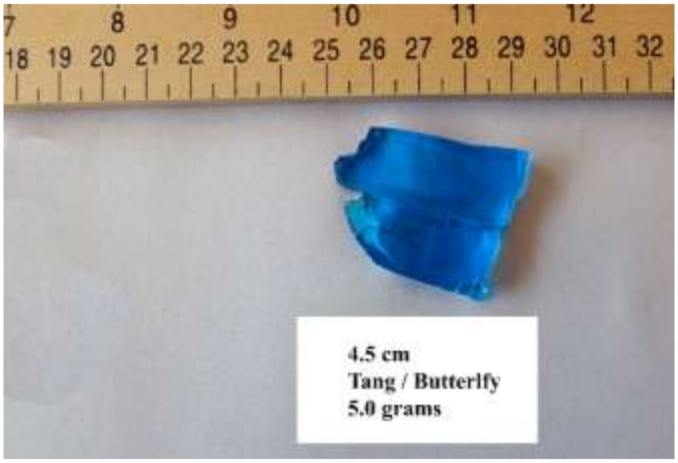
| | | | |
|---|---|---|---|
| Queen Angel | *Pomacanthus* | 14.5 | 123.0 |
| Soldierfish | *Myripristis* | 14.5 | 58.0 |
| Duboulayi Angelfish | *Chaetodontoplus* | 14.8 | 106.3 |
| Trigger | *Balistapus* | 14.8 | 141.8 |
| Anglerfish | *Antennarius* | 15.0 | 150.0 |
| Naso Tang | *Naso* | 15.0 | 52.0 |
| Trigger | *Balistes* | 15.1 | 127.6 |
| Yellow Tang | *Zebrasoma* | 15.5 | 120.5 |
| Flagfin Angelfish | *Apolemichthys* | 16.0 | 119.0 |
| Scorpionfish | *Scorpeana* | 16.0 | 112.0 |
| Pinecone Fish | *Monocentris* | 16.5 | 185.0 |
| Bamboo Shark | *Chiloscyllium* | 17.0 | 14.4 |
| Leather Grouper | *Epinephelus* | 17.0 | 155.0 |
| Bamboo Shark | *Chiloscyllium* | 17.1 | 14.7 |
| Anglerfish | *Antennarius* | 18.0 | 142.0 |
| Harlequin Tuskfish | *Lienardella* | 18.0 | 124.0 |
| Harlequin Tuskfish | *Lienardella* | 18.5 | 125.9 |
| Navarchus Angel | *Euxiphipops* | 18.5 | 217.0 |
| Pipefish | *Syngnathus* | 18.8 | 20.0 |
| Hardwick's Wrasse | *Thalassoma* | 19.0 | 97.5 |
| Cowfish | *Aracana* | 20.0 | 600.0 |
| Wrasse | *Thalassoma* | 20.3 | 130.0 |
| Blue Spot Ray | *Taeniura* | 20.5 | 356.5 |
| Dottyback | *Labracinus* | 21.0 | 125.0 |
| Seabass | *Anthias* | 21.0 | 250.0 |
| Lionfish | *Pterois* | 21.6 | 415.0 |
| Jack | *Caranx* | 22.0 | 190.0 |
| Lookdown | *Selene* | 22.5 | 212.0 |
| Lookdown | *Selene* | 23.5 | 245.0 |
| Lyretail Wrasse | *Thalassoma* | 24.0 | 167.7 |
| Scorpionfish | *Scorpeana* | 29.0 | 510.0 |
| Grouper | *Epinephelus* | 29.2 | 410.0 |
| Wrasse | *Thalassoma* | 30.0 | 375.0 |
| Wrasse | *Anampses* | 30.5 | 454.0 |
| Lionfish | *Pterois* | 35.0 | 1106.8 |

**Direct Fish Length/Weight Relationships – use as examples for estimation**

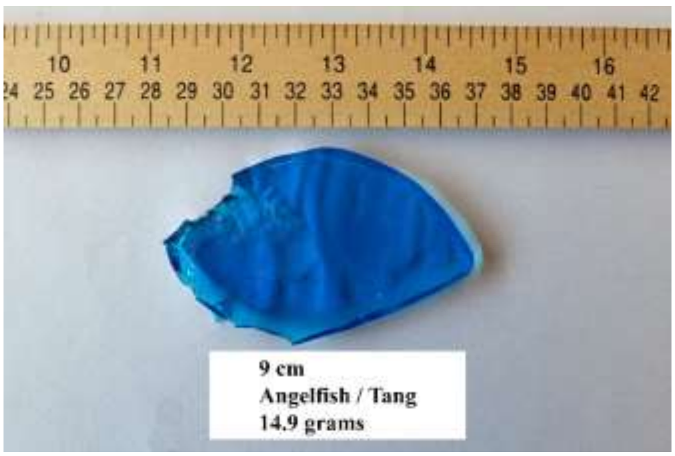

2 cm
Tetra / guppy
0.20 gram


2 1/2 cm
Pygmy goby / Trimna sp.
0.60 grams


3.5 cm
Clownfish
2.0 gram

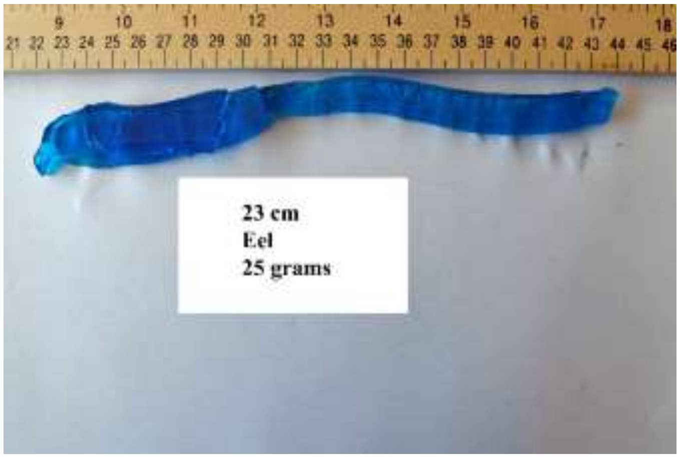



4.5 cm
Tang / Butterlfy
5.0 grams




9 cm
Angelfish / Tang
14.9 grams


13.5 cm
Cichlid / Grouper
30 grams



**Mock fish – to be used as indirect comparison of fish length/weight estimates**

**Case history:**

An aquarium housing 13 rather small fish needed to be treated with oral antibiotics. The veterinary recommendation was to use erythromycin, dosed at 100 mg/kg fish body weight in the diet for 14-21 days.

The first step was to estimate the fish mass in the aquarium (in this case, but comparing to a known weight data set). 10 platies (about 5 g total) 1 goldfish at around 40 g, one or 2 danios at 2 g and one large tetra and 10 g, for a total mass of around 57 grams.

For the erythromycin dose, that works out to be 5.7 mg of erythromycin fed to the whole tank each day.

One usually assumes that the fish will eat around 3% of their body mass each day, so for this system, that works out to be 1.7 grams of food per day. Therefore, we need 5.7 mg in 1.7 grams of food, or 670 mg in 200 grams of medicated food.

Erythromycin is soluble in ethanol. Dissolving 670 mg of erythromycin in the smallest amount of ethanol possible and then spray it on to 200 grams of flake food and allow it to evaporate. The fish were then fed 1.7 grams of food daily (spread over three feedings).