

Livebearers

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What should you feed your fish?

Michi answers this question and more!

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J U S T A S K A S C I E N T I S T !

Question:

I always struggle to decide what foods to buy for my fish, there is just such a huge selection. What do you pay attention to when you decide what to feed? How do you feed the livebearers in your fish room?



Michi Tobler

Michi Tobler is a fish biologist who studies the ecology and evolution of livebearers at Kansas State University. In his spare time, he usually has some meat in the smoker and a good book in his hands.

I agree! The selection of different fish foods has grown vastly. It's like cereal! Really... just like cereal: no matter what you buy, it's probably going to be crap, but the kids will eat it anyway. Now before I draw the wrath of all the fish food producers, let me give you a more nuanced response...

Why it's probably not *that* important what processed food you buy

Thanks to the aquaculture of fish for human consumption—from salmon to catfish and tilapia—we know a lot about fish nutrition. Fish farmers and pig farmers alike want to minimize production costs and maximize yield, so there has been a large research effort to understand what types of food make fish grow fast and large. Like all other animals, fish require protein, lipids (fats), carbohydrates, as well as minerals and vitamins to survive, grow, and reproduce.

Protein is the most expensive component of fish food, and protein content varies widely between different products (mostly between 20–40%). Proteins are critical for fish growth and the maintenance of the body. **Lipids** are also critical in fish diets, because they supply the

body with energy and essential fatty acids required to build cells in the body. While lipids are cheaper than protein, high-fat diets can be problematic for fish health and decrease reproduction; hence, lipid content in fish food is usually between 10–25%. In addition, high fat content can reduce the shelf-life of fish food, because especially unsaturated fats readily react with oxygen and become rancid. **Carbohydrates** are the cheapest ingredient in fish food and make up about 15–20% of fish food. They are non-essential for most fish, and unlike mammals, fish are unable to use carbohydrates as an efficient source of energy. Nonetheless, carbohydrates are typically found in commercial fish food, both because they are critical to make the proper structure of the food (i.e., a flake or a pellet) and to reduce the cost of food production. Finally, fish food also contains a number of vitamins and minerals. Some products also contain additives like astaxanthins that are important for the expression of certain colors in the fish skin.

How much of each dietary component is needed really depends on the life stage and the biology of each species, both in terms of its natural diet and the environ-



Processed Foods The most commonly seen varieties are pellets and flake

ment it is found in (temperature, water quality, stocking densities, etc.). For example, younger fish that go through periods of rapid growth require high protein diets. In addition, fish with different dietary habits also have different protein needs, with herbivorous fish requiring a relatively low protein content in their diet and carnivorous fish requiring higher protein content. There are also some significant differences in lipid requirements among species, especially between marine and freshwater fishes.

The peculiar thing is that fish primarily modulate their food intake to cover their energetic needs. So, if there is too little protein in the diet relative to lipids and carbohydrates, fish will reduce the food intake and cease growing due to the lack of protein. In that situation, you can feed all you want, but it won't improve the growth your fish. On the flip side, if there is too much protein in the food, fish cannot cover their energetic demands from lipids and carbohydrates. In this case, fish are also able to gain energy from protein, but the consequence is that a lot of the nitrogen included in proteins gets split off and is excreted by the fish in the



Kansas State University Green House

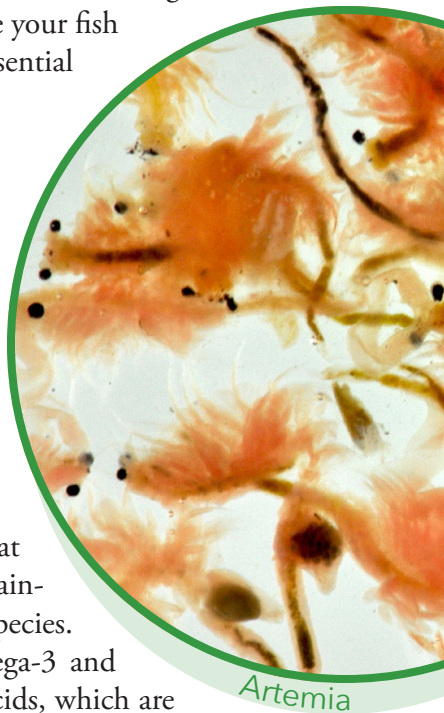
form of ammonia. Ammonia is toxic for fish, but in well-run aquaria it is converted to nitrite and nitrate by the filter bacteria. Either way, excess protein in the fish diet essentially causes water quality issues, which can become problematic for fish health when not managed well. So, considering all of this, what do I pay attention to when I choose food products for my fish?

1. Most importantly, I first take a look at the dietary habits of the fish I want to keep. Each species has an optimal protein-to-energy ratio. Of course, we don't really know that optimal ratio for most species, but you can get close enough by categorizing them into broad dietary groups (herbivore, omnivore, carnivore). So, those food labels that are used to market foods for those different groups are actually useful, and they will definitely get you in the right ballpark. Note that there is quite a variety of dietary specializations in *Poeciliids* and other livebearers. Many mollies and swordtails are perhaps best classified as herbivores, whereas others (e.g., *Gambusia*, *Brachyrhaphis*, and *Phallichthys*) have much more protein-rich diets consisting of aquatic insects.
2. If you are raising fry, especially in high-density tanks, you will definitely want to provide more protein-rich diets. This is true even for herbivores that have lower protein needs as adults.
3. Once you have a product with the right amount of protein for my fish, I opt for products with higher lipid content and lower carbohydrate content, mostly because carbs are not really useful for the fish. That invariably means that you opt for a more expensive product, but you get what you pay for.
4. Avoid diets designed for marine fish when you are feeding freshwater fish, and vice

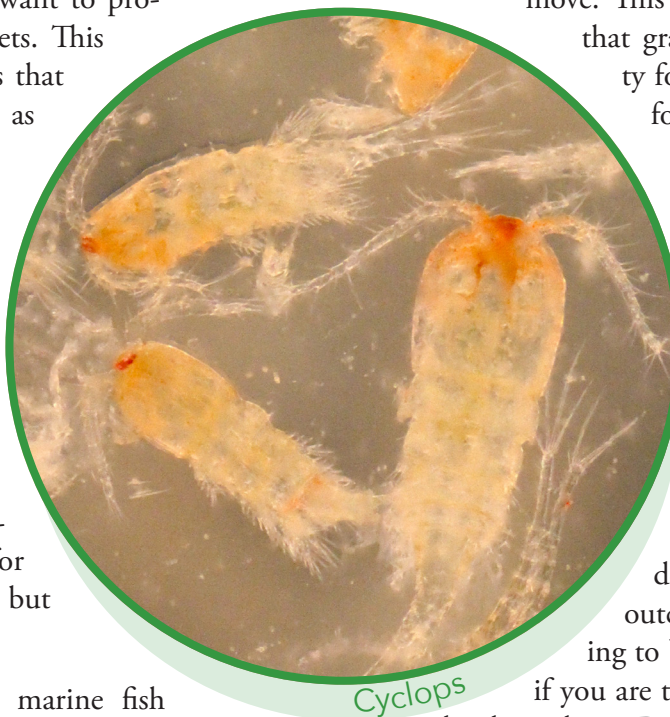
versa. Marine and freshwater fish have some differences in nutrient requirements, and feeding the wrong diet may cause your fish to miss out on some essential dietary components.

Why you can only get so far on processed food

While you will be able to cover the nutritional needs of most commonly found fish species in the hobby using commercially produced flake and pellet foods, these dry goods have some inherent limitations that can prevent the successful maintenance of more finicky species. Chief among them are omega-3 and omega-6 unsaturated fatty acids, which are almost absent in dry foods but critical for the health of many freshwater fish species. In addition, dry foods are highly nutritious, they are often avoided by fish after being in the water for too long, and they don't move. This can be problematic for species that graze continuously on low quality food, forage slowly, or prefer live food.



Artemia



Cyclops

So, flakes and pellets make for a good base diet because they are very convenient, and they have been developed really well through thorough research (maybe with the exception of some bottom shelf producers). However, supplementing the base diet with additional items can definitely help you get better outcomes, especially if you are trying to breed fish in larger quantities or

if you are trying to work with fish that are harder to keep. Diet supplementation can be done through addition of specific vitamins and micro-nutrients

(see below), frozen insect larvae and crustaceans, fresh leaves and vegetables, as well as live feeder animals that you can either culture or collect in nature.

What we feed



Cyclops

So, how do we feed out livebearers at Kansas State University, where we have a decently large operation (about 250 regular fish tanks and 50 larger tubs in a greenhouse, encompassing about 7500 gallons of water)? At that magnitude cost (for fish food) and time (for feeding and maintaining water quality) definitely becomes an issue. In addition, we try to accommodate a variety of species with different nutritional requirements without having to adhere to drastically different feeding regimens

for different tanks, and we try to keep reproductive rates high and fish growing well so we can work with them for our research.

To accomplish that, we use a very protein-rich base diet consisting of a powder (50% protein, mixed with decapsulated *Artemia* eggs), which sinks slowly and is consumable even by small fry, and larger pellets (40% protein), which are very hard, dissolve slowly, and float, allowing fish to feed on them continuously for some period of time. The fish receive powder and/or pellets at least once a day, which most definitely puts a strain on the water quality of our system. This feeding regimen requires good filtration and frequent water changes (we change about 40% each week) to make sure waste products are properly disposed of.

On top, we use several ways to supplement the diets of

our fish, usually once daily from Monday through Friday. Supplementation varies somewhat depending on the species and the specific tank; so this is where we can provide some extra care and attention wherever needed.

Perhaps the most critical supplementation is our addition of unsaturated fatty acids to the diet. These fatty acids can be purchased as an emulsified liquid (e.g., SELCO). Alternatively, you can just use regular fish oil that is available as a supplement for humans. However, the problem was always how to get a liquid supplement effectively into the fish. We solved this by offering gel foods, which have recently gained popularity in the hobby, and adding fatty acids to the gel during the preparation process. These gels have to be refrigerated or frozen to make sure they maintain their quality, and feeding them is clearly more labor intensive than just using flake food. In addition, our fish also get frozen foods (bloodworms, adult *Artemia*, and *Cyclops*) multiple times a week. Smaller species—especially in tanks with fry—are also supplemented with living *Artemia* nauplii.



Bloodworms

Just Ask a Scientist!

will hopefully be a regular component of Livebearers in the future.
However, this requires your input.

Have you ever wondered about the meaning of observations you made in your fish tank?
Do you have questions about the behavior, reproduction, ecology, or evolution of livebearers?

Submit your questions directly to Michi:

tobler@ksu.edu

He will do his best to answer your question or find somebody that can.

