Cycling Part II

Starting up an Aquaponics System without Fish

BY SYLVIA BERNSTEIN

In the last issue of Maximum Yield, Sylvia Bernstein offered a few tips and tricks on how to start up (cycle) an aquaponics system by adding fish right away. This time around, she has returned to explain an alternate technique to cycling that doesn’t involve any fish at all.
Starting up your aquaponics system (cycling) is a straightforward process if you know what to look for and have a procedure to follow. In a nutshell, you add ammonia to your aquaponic environment and over time, naturally occurring, nitrifying bacteria find your system, establish themselves and proceed to convert the toxic ammonia first to nitrites and then to harmless nitrates.

Fish are the obvious source of ammonia to cycle your system since their waste is the eventual fuel that feeds any aquaponics system. Fish excrete ammonia through their gills during their respiratory process, which if left unchecked, will increase in concentration and will eventually poison the fish.

The alternative is called fish-less cycling—getting ammonia into your system by some means other than from fish. This technique has a few major advantages. First, there is much less stress involved (for you and the fish) because you are not trying to keep anybody alive during the process. Because of this, you need be much less concerned about pH since the pH must only be kept in a range that facilitates cycling without consideration for the safety of the fish.

Second, because you can elevate the ammonia concentration to a higher level than would be safe for fish, you can cycle your system in much less time (generally 10 days to 3 weeks versus 4 to 6 weeks when you cycle with fish) and end up with a more robust bacteria base once you are cycled. The practical result of this is that you can fully stock your tank once cycling is complete, versus gradually increasing the stocking levels as is recommended when cycling with fish. This is especially beneficial to those who are growing aggressive or carnivorous fish because they are less likely to attack each other if everyone is introduced to the tank at the same time.

Finally, you can more precisely control how much ammonia is added to your system during the process. For example, if you see that your ammonia level is creeping up to 8 ppm, but no nitrites have shown up yet, just stop adding ammonia for a few days and let the bacteria catch up. You can’t do this with fish!

There are several ways to add ammonia to your system, ranging from the obvious to the slightly bizarre. I will talk about the pros and cons of each, and you can decide for yourself which makes the most sense to you.

**LIQUID AMMONIA**

This is the old-fashioned cleaning product your grandmother used, which filled the room with the smell of ammonia. Only use it if you can find the pure form that is made strictly out of ammonia (usually 5 to 10% by weight) and water. Avoid anything with perfumes, colorants, soaps, surfactants or any other additives. Shake the bottle. If it foams or if it doesn’t list the ingredients or say clear ammonia, pure ammonia, 100% ammonia or pure ammonium hydroxide, leave it on the shelf.
**THE HUMONIA approach creates a more complex biological environment than pure, synthetic forms of ammonia and thus introduces some risk to the cycling process and the health of your system.**

**CONs**—It can be hard to find if you don’t have a cleaning supply or a good hardware store nearby. I’m told it is entirely unavailable in Australia since 9/11 because of the remote association as a possible ingredient in bomb making.

**AMMONIUM CHLORIDE**
This is the same concept as the liquid ammonia, but you can find ammonium chloride (crystallized ammonia) through aquaponics stores, aquarium supply stores, soap supply stores, photography supply stores and chemical houses.

**PROs**—Because it is very concentrated and in dry form, it is inexpensive to ship. If you get the kind intended for aquaponics and aquariums, there will be little doubt that it is pure and will work in cycling.

**CONs**—There will be some cost involved and it is sometimes hard to find in small quantities.

**HUMAN URINE**
Otherwise known as humonia or peeponics, adding human urine to an aquaponics system may sound gross. But when you think about it, human urine is actually an excellent source of ammonia just as the waste product from any animal would be. Human urine is just easier to capture. Here is the catch: to go from urea to ammonia, you should put it into a sealed bottle for a few weeks to percolate. Can you just urinate straight into the fish tank? Sure, but the problem is that since that urine will take a while to convert into ammonia, you will have no way of telling just how much potential ammonia you have in there. The levels will read very low and then all of a sudden one day they will explode.

The hardest part of cycling with pure ammonia can sometimes be finding the ammonia. Try your local hardware store, cleaning supply store or even well-stocked super stores. If all else fails, you can order it online.

**PROs**—It is relatively inexpensive (approximately $20 for a gallon) and what you don’t use to cycle your aquaponics system can be used to clean your windows! Plus, you know exactly what you are adding to your system with this product—ammonia and water, nothing more, nothing less.
A final concern around humonia is that there may be bacteria or germs in your digestive system that could be harmful to the fish or the nitrifying bacteria. In general, the conversion to ammonia in that sealed container will destroy most of this. However, the humonia approach creates a more complex biological environment than pure, synthetic forms of ammonia and thus introduces some risk to the cycling process and the health of your system.

**PROS**—This is a free and readily available source of ammonia.

**CONS**—There is the yuck factor—you have to store the urine until it converts to ammonia—and there is a possibility that harmful bacteria or germs from your digestive system are transmitted to your aquaponics system.

### OTHER SOURCES OF AMMONIA

As animal flesh decays it lets off ammonia. I saw a suggestion on a forum once for cycling your system using a bit of dead fish, but dismissed this concept as too bizarre. Then I was testing one of my fully established, rock solid tilapia systems with a group of people who had just taken a class from me and were learning about maintaining their system. Imagine my embarrassment when the ammonia reading was off the chart. Turns out a fish had died in the back corner of the tank and hadn’t floated to the surface.

**PROS**—This is another free and readily available source of ammonia.

**CONS**—Again, because other bacteria and chemical compounds are given off during the decay process, there is a chance that you will introduce something undesirable to your aquaponics system, not to mention the chance of attracting flies or other insects that want to assist in the decomposition. The other issue is that it will be difficult to control how much ammonia gets into your system with this method.

### INSTRUCTIONS FOR FISHLESS CYCLING

Once you have identified your source of ammonia you are ready to start the cycling process. Just follow these simple instructions:

**INITIALLY**

Add ammonia to your fish tank until you get an ammonia reading between 2 and 4 ppm.

If you have a fish tank that is smaller than 100 gallons, I recommend adding only ½ a teaspoon, or less, at a time, then testing. Half a teaspoon of ammonium chloride (a powder) should give you close to 3.4 ppm of ammonia in 100 gal. of water. It will take about 5 tsp. of 10% clear ammonia to reach the same target of about 3.4 ppm. Given these two data points you can extrapolate about how much ammonia you should add for the volume of water you are cycling based on the strength of the ammonia you are using.

If your tank is larger than 200 gal. you can add more than a teaspoon of ammonium chloride at a time. To gauge how much, note that a teaspoon of ammonium chloride powder in 200 gal. of water will give about 3.4 ppm of ammonia. If you are using a 10% aqueous solution, adjust accordingly per the instructions above. If you are using powder, let the powder mix run through the system for a couple of hours just to be safe and then re-test ammonia. A liquid will integrate more quickly.
If you add too much ammonia (i.e. the ammonia test shows more than 6 ppm), drain some of the water in your tank and dilute the remaining tank water with fresh water.

**NOTE:** If you see zero ammonia in your test you may have added far too much and overwhelmed the test. Try re-testing with a highly dilute sample of your tank water.

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**EVERY DAY THEREAFTER UNTIL YOUR SYSTEM IS CYCLED:**

- Test your water for ammonia, nitrites, and pH levels and record them.
- Adjust pH to get it back to 7.0 to 7.8 if necessary. A pH level of up to 7.8 during cycling is fine as long as you have not planted your system yet. The nitrifying bacteria actually prefer a slightly basic environment.
- Add ammonia to get the ammonia level back to 2 to 4 ppm if it has dropped (if it has, that is good news—it means that nitrifying bacteria has found your grow bed and begun eating your ammonia).
- If you are seeing measurable amounts of nitrites, then start measuring nitrates as well. Nitrates are the next step in the cycle.

As soon as ammonia and nitrites drop to close to zero and you are seeing measurable levels of nitrates, you are fully cycled and ready to add fish. Once you have added fish you can stop adding ammonia—the ammonia from the fish waste replaces the ammonia you have been adding to feed the new bacteria.

At this point you can also add plants. Once the plants are in your system you should start targeting a pH level of 6.8 to 7.0 because the plants require a lower pH than the bacteria in order to take up nutrients. More on how to adjust pH for aquaponics in upcoming articles.