



The basic aquaponics system has fish, plants, tanks and a pump to move water. The wastewater and sludge from the fish tanks contain more nitrite, nitrate, ammonia and phosphate than plants can take up. As a result, current aquaponic systems discharge considerable amounts of water each day (up to 20%) and replace it with fresh water. BiG researchers are studying additional subsystems that may improve operational parameters, recycle nutrients, reduce costs, increase revenue streams and reduce waste output. These are described in the following paragraphs.

Researchers are studying microalgae to improve treatment of aquaponic wastewater. Algal bioreactors can help with nitrogen removal but do not remove all N, so the remainder is converted to nitrite and nitrate for plant crop use. Algae cells are further processed to create an algae slurry that is treated along with sludge from the fish tanks and vegetable wastes in an anaerobic digester and biogas boiler.

BiG researchers hypothesize that adding an anaerobic digester to the aquaponics system will remove organic carbon from wastewater and produce more plant nutrients in solution to allow higher plant production. The algal slurry that remains after algae nutrient removal is then biorefined or treated in an anaerobic digester and biogas boiler to create biofertilizer; nutraceutical ingredients such as bioactive peptides, and phenolic compounds; and fish feed ingredients. The anaerobic digester and biogas boiler are used to create digestate, energy and biofertilizer using the algal biomass.

This additional cycling of nutrients in the system and anaerobic digestion subsystems offers the promise of decreasing waste and generating fertilizer and biofuels. Researchers hope these system components will fully recycle the nutrients as resources for energy generation to power the system and achieve a zero-waste aquaponic operation. To complete the system, the fish and plants must also be processed.

Glossary

Bioactive peptides: Protein fragments with several amino acids — resulting from physical, chemical or enzymatic protein hydrolysis — that have a positive impact on physiological functions or conditions leading to improved health.

Biofertilizer: A product that is not chemically synthesized, is biodegradable and is usable as a fertilizer.

Digestate: The material remaining after the anaerobic digestion (decomposition under low oxygen conditions) of a biodegradable feedstock.

Phenolic compounds: Phenolic and polyphenolic products, either alone or in combination with vitamins, such as carotenoids, vitamin E, and vitamin C, that can serve as antioxidants to protect various tissues in the human body from oxidative stress.

Sludge: Fish excrement. A muddy or slushy mass, deposit, or sediment.