Aquaponic System Construction and Maintenance

Carmen Liberatore

Dr. Paula Turkon

Aquaponic systems have become more and more popular in recent years, and obtained organic status in 2017. They have been installed in many areas, and with many goals, ranging from large-scale industrial farms to small family systems. While arrangements and goals may vary, they always include the same components. Hoses connect the fish tanks to the grow beds, to allow water and fish waste to flow into the grow beds. The plants in the grow beds take nutrients from the fish waste and filter the water, which is then cycled back into the fish tank. This closed-system concept has many enthusiasts touting aquaponics as the savior to various food and hunger issues around the world. While there is still controversy surrounding the sustainability and nutritional value of aquaponic crops and its newly-obtained organic status, it remains one of the most efficient methods of food production. With more research arising on aquaponic systems comes increased awareness and installations, resulting in more efficient food production.

Since 2013, Ithaca College has supported various aquaponics research projects varying from nutrient comparisons to community outreach. This year's research projects include nutrient comparisons of aquaponics produce to grocery store produce, pathogen presence in various systems, economic construction methods, and input reduction experiments. These research projects aim to improve the efficiency of aquaponics, their safety, and public awareness.

People who are new to aquaponics may find this method of food production very confusing. This paper/poster will explain the history, operation and are maintenance, of aquaponics systems to provide background information to the research projects of the rest of the aquaponics team.

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Whalen Symposium 2018

Escherichia Coli and Salmonella Presence in Hydroponic and Aquaponic Systems: An Exploratory Case Study

Alternative food systems have become increasingly popular among hobbyists, produce growers, and in academia in the United States. Hydroponics, which is a means of growing plants in nutrient fortified water instead of soil, and aquaponics, which is a means of growing plants while raising fish in a recirculating system, are just two of these alternative food systems. These systems are gaining popularity in the United States for their ability to grow produce year-round, lack of pesticide and artificial fertilizer use, ability to conserve water, and efficient growth given space and location constraints. Yet, they are not commonly used outside of small experimental and/or isolated projects. One of the possible reasons that these alternative forms of food production are not integrated as mass-production food methods is due to concerns that the produce may be contaminated by pathogens. This study aims to demonstrate that alternative food systems, such as aquaponics and hydroponics, are viable forms of production on the basis of their low or non-existent levels of E. coli and Salmonella contamination, which are two of the most prevalent sources of food borne illness in the United States. 100 mL water samples were collected weekly from a total of 5 hydroponic systems and 3 aquaponic systems in the Ithaca, NY area. Site locations included the hydroponics and aquaponics research laboratory at Ithaca College, Ithaca College's terraces dining hall, a home in Ithaca, and a Cornell greenhouse. Samples were mixed with an IDEXX brand reagent mixture, incubated for 24 hours, and then enumerated for the most probable number of E. Coli and total coliforms. Results, thus far, show that E. coli is not present in approximately 98% of the samples, and if it is present, it is isolated to one location. Further, Salmonella was not detected in any samples. Results were compared to the Food Safety Modernization Act's standard for agricultural water of 126 colony forming units or less of generic E. coli. All samples had significantly fewer colony units than the agricultural water standard. This study can conclude that these specific aquaponic and hydroponic systems are safe for produce growing, and in turn, support the argument that they are also safe for human consumption.

Aquaponics as a Mitigator of Nutrient Deficiencies in U.S Urban Food Deserts

Lisa Niederman class of 2018

Paula Turkon

The USDA defines food deserts as areas that have no or limited access to fresh fruit, vegetables, and healthy whole foods. Such areas typically occur in low-income areas– urban or rural– where there is a scarcity of grocery stores, farmers' markets, or other nutritious food providers. Limited access to such food can lead to various nutrient deficiencies and a multitude of health problems. Food desert areas are also likely to disproportionately affect people of color, have a high disabled population, and have limited access to health care and education. My research will examine how lack of access to healthy food and deficiencies in Beta-Carotene (Vitamin A), Absorbic Acid (Vitamin C), and Folic Acid affect people, specifically women and developing children, in their daily lives and anticipated future. In considering solutions to food desert prevalence, I look to contemplate aquaponics as a potential mend. Aquaponics is a form of sustainable agriculture that combines aquaculture– the farming of fish, and hydroponics– the growing of plants in water with added synthetic nutrients, into a closed-loop system. Fish excrement acts as the fertilizer and nutrient-source for the plants, while plants act as natural water filters for the fish. These systems are compact and can be maintained indoors with limited space, making them attractive options for urban agriculture. For my research I will report the results of a nutritional analysis of collard greens from Ithaca College's aquaponics system compared to the local Wegman's produce to determine if aquaponic collards are as nutritious as store bought collards. I focus on three nutrients most commonly deficient in inner city women and children, Beta Carotene, Ascorbic Acid, and Folic Acid, and ask how this result affects the desirability of aquaponics systems in urban food desert areas. Is aquaponics a feasible method of addressing nutrient deficiencies and facilitating fresh-food access in American urban food deserts?

Aquaponics in Trumansburg Middle School

Claudia Hart
Dr. Paula Turkon

Interacting and working with plants and animals can be a useful educational tool to increase the learning capacity of grade school children. Extensive research has shown that kids, and especially those who struggle with disabilities, benefit from visual and hands-on active learning. Aquaponics is a self-sustaining agricultural system that incorporates the interaction between plants and animals. Aquaponics is an ideal pedagogical tool for special needs grade school children because, in order to be successful, it requires a group effort of daily maintenance, observation of fish and plant health, which leads to an understanding of biological requirements and etc. As an additional bonus, aquaponics systems have the ability to grow food, which then can be used in cooking projects.

This **paper/poster** describes the incorporation of an aquaponic system installed in a special needs classroom of Trumansburg Middle School. I will present examples of weekly lesson plans focused on developing knowledge including, but not limited to: the nitrogen cycle, plant and animal health, and why such a system brings light to our agricultural future.

Aquaponics should be implemented in all schools across the United States to help aid in higher education because it offers educators a great tool to achieve higher learning outcomes among students. By way of students having the ability to understand such a system, they have the skills and knowledge to be able to create their own system at home, grow their own food, and also harvest their own fish as a future meal.

Abigail MacKenzie

Faculty Advisor: Paula Turkon

Manipulation of Nutrients in Daphnia to be Used as Fish Food in Aquaponics

Aquaponics is a valuable field of study because it allows us to become closer to our food system as well as reduce water input when compared to growing in soil. The ongoing goal of the Aquaponics system led by Paula Turkon at Ithaca College is to reduce the amount of energy inputs to make aquaponic food production more sustainable. This research project addresses two ongoing project goals. First, it explores alternatives to one of the highest inputs, the food fed to the fish. The research will focus on using Daphnia, a genus of small planktonic crustaceans, as an alternative source of fish food. Since Daphnia are easy to breed, and contain good nutrition for fish, they are potentially a good source of nourishment for the tilapia in an aquaponics system. Second, we hypothesize that our current system is rich in Nitrates but lacking in Phosphates. This project will manipulate the nutrients fed to the Daphnia in order to raise the phosphate levels and benefit the plants. This paper/poster will provide preliminary research on nutrient needs of plants in comparison to available nutrients in the aquaponics system water, as well as present a preliminary methodology and expectations for the larger project in Fall 2018. Studies like these can help to ensure productive fish and plant growth as indoor food production becomes a greater part of our food system. The desired outcome is a more sustainable fish food that promotes fish health and plant growth by adding important nutrients, such as phosphorus, to the system.