PRELIMINARY STUDY OF WATER QUALITY AND LEAFY GREEN GROWTH IN AQUAPONICS: A BASELINE FOR MICROBIOLOGICAL SAFETY ASSESSMENT

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Abstract

Aquaponics integrates aquaculture and hydroponics into a closed-loop system in which fish waste provides nutrients for plant growth, and plants help maintain water quality. Leafy greens are consumed raw, and establishing baseline water-quality data is essential for future microbial-safety assessments. This study monitored a shipping-container aquaponics system growing Swiss chard, lettuce, and basil with tilapia over nine weeks. Daily measurements included temperature (20–31 °C), dissolved oxygen (6.95–9.31 mg/L), salinity (0.12–0.30 ppt), and pH (6.34–7.54). Weekly analyses quantified ammonia (0.02–0.44 mg/L), nitrite (0.01–0.515 mg/L), nitrate (2.9–29.0 mg/L), and iron (0.02–1.01 mg/L). Water quality remained within acceptable ranges for tilapia, with nitrate steadily increasing and ammonia/nitrite staying low, indicating stable nitrification. Swiss chard showed the strongest growth, lettuce performed moderately with some browning, and basil had weaker growth. These findings provide foundational baseline data to support upcoming microbial safety evaluations of aquaponics-grown leafy greens.

Keywords: Aquaponics, Tilapia, Water Quality, Leafy Greens, Food Safety

Introduction

Aquaponics integrates aquaculture and hydroponics into a recirculating system in which fish waste serves as nutrients for plant growth (Chandramenon et al., 2024). It uses up to 90% less water than conventional farming and reduces reliance on fertilizers (Alhaj Hamoud et al., 2023). Leafy greens such as Swiss chard, lettuce, and basil grow efficiently due to their short cycles and high market value (Lopchan Lama et al., 2025). Maintaining optimal water quality, like temperature, dissolved oxygen, pH, salinity, and nitrogen compounds, is critical for stable system performance (Fox et al., 2012). Aquaponics may also improve food safety by avoiding soil contact and manure use (Vermeersch et al., 2025), yet contamination by pathogens like *Salmonella* and *Listeria monocytogenes* remains a concern. Recent soilless leafy green recalls underscore the need for microbial safety data. Shipping-container systems offer sustainable, space-efficient production but lack baseline information on water quality and crop performance. This study provides data to support future microbial-safety evaluations and preventive controls.

Significance of the study

- This study establishes baseline water quality and crop growth data in aquaponics to address microbial safety concerns raised by recent recalls of soilless leafy greens.

Objectives

- Monitor daily and weekly water quality parameters over nine weeks.
- Evaluate the growth performance of Swiss chard, lettuce, and basil.
- Generate foundational data that will support future pathogen testing and development of preventive safety controls.

Materials and Methods

❑**Location:** Shipping-container aquaponics system (Fig. g).

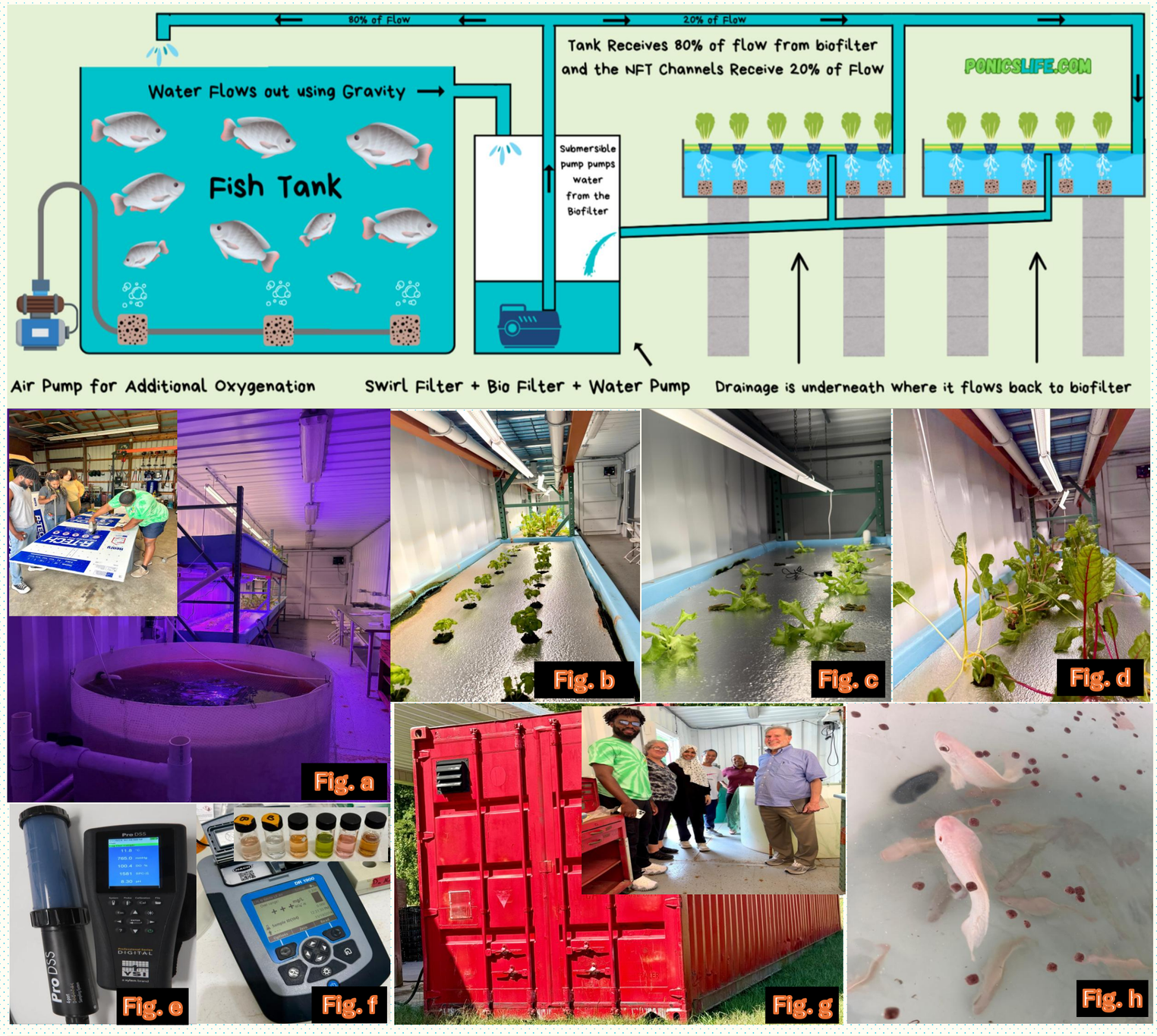
❑**Fish:** 20 tilapia cultured in recirculating tanks (Fig. a and h).

❑**Crops**: Basil, lettuce, and Swiss chard (Fig. b, c, and d).

❑**Water Quality Monitoring:**

✓**Daily:** temperature, dissolved oxygen, salinity, pH (with YSI Pro DSS-Fig. e).

✓**Weekly:** ammonia, nitrite, nitrate, iron (using DR/2500 spectrophotometer).



Results and Discussion

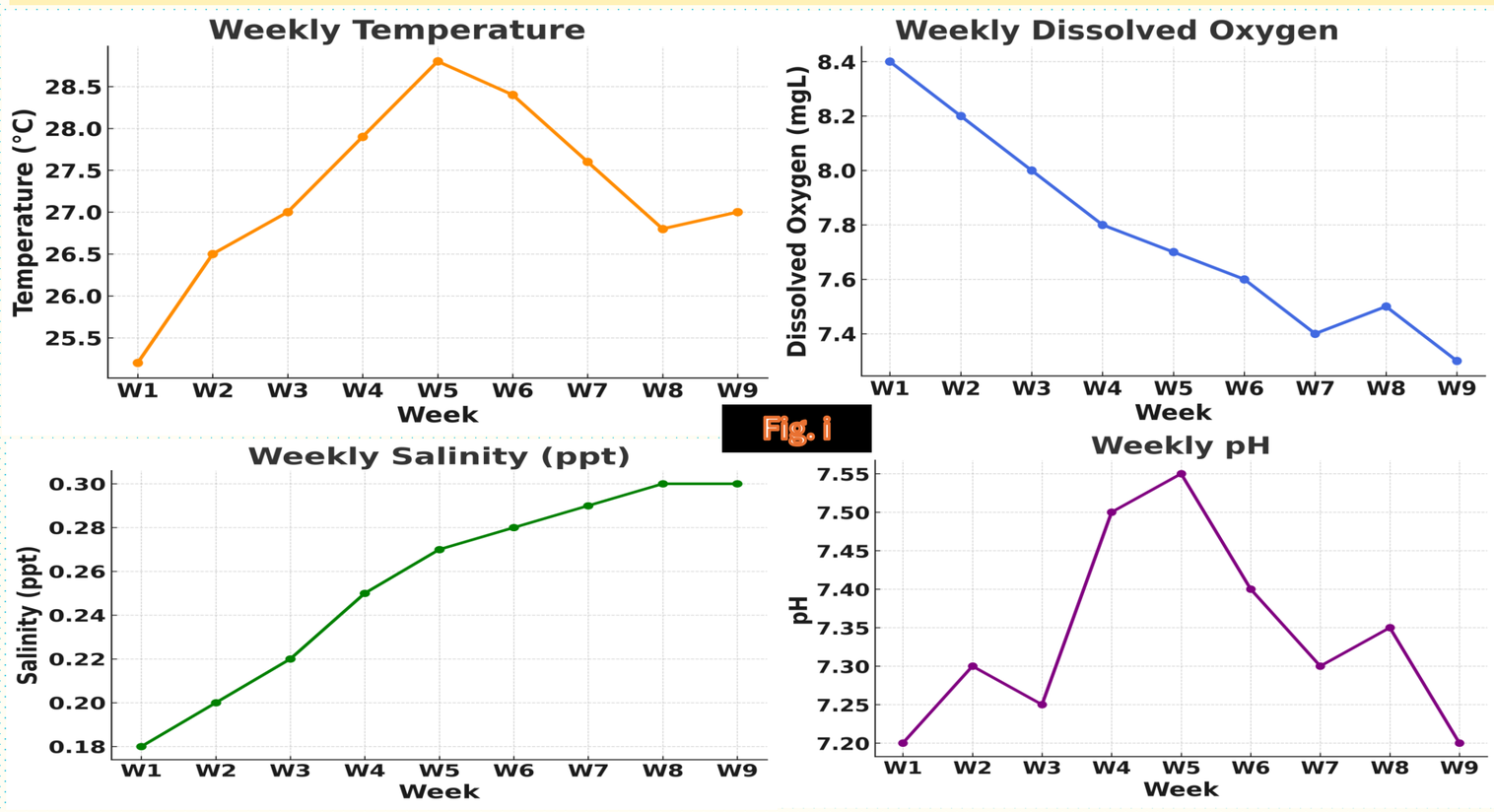


Fig. i: Weekly temperature, dissolved oxygen, salinity, and pH trends

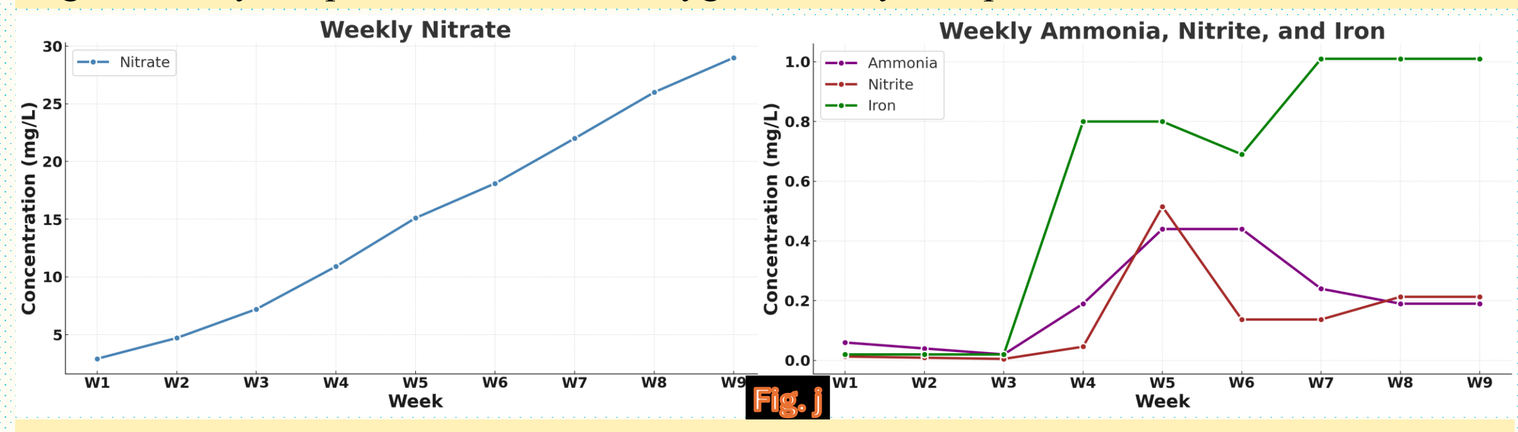


Fig. j: Weekly nitrate, ammonia, nitrite, and iron concentrations

Conclusion and Future Goals

- The shipping-container aquaponics system can maintain stable water quality parameters while supporting leafy green production.
- Swiss chard performed the best, followed by lettuce and basil.
- Future work will focus on microbiological safety assessment of leafy greens to evaluate potential risks from pathogens.
- Linking nutrient dynamics with crop performance.
- Developing preventive controls and food-safety guidelines for aquaponics-grown produce.

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