COMPARING BASIL (Ocimum basilicum) PRODUCTION IN HYDROPONIC AND AQUAPONIC SYSTEMS

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Abstract: Soilless farming, though it has been around for over two millennia, is becoming more prevalent in modern food production as it not only saves water and space but also provides an effective option for indoor urban farming. There are currently two major models of soilless farming—hydroponics and aquaponics. While both systems are effective, very few studies compare the two. The objective of this study was to compare the water quality, basil (Ocimum basilicum) productivity, and basil essential oil profiles from plants grown in a hydroponic and newly established aquaponic system. Basil plants from two age groups (young plants and old plants) were measured during, before, and after a four-week growth period in either a hydroponic or aquaponic system. Water quality was also analyzed before, during, and after the growth period, and essential oils were evaluated from harvested basil. Whereas older aquaponic plants seemed to grow better initially (p=0.001 for leaf number and p=0.002 for leaf density), at the end of the growth period it was younger hydroponic plants that had increased leaf number (p=0.0013) and stem height (p=0.0014). Both water quality and essential oils differed between the systems as well, with the aquaponics system having more stable nutrient supply and lower concentrations of essential oils. These data show that aquaponic and hydroponic systems show differences in water quality, basil productivity, and basil-leaf essential oil profiles.

Introduction:
- Human population growth necessitates more sustainable means of food production.
- Soiless farming saves water and space and also provides an effective option for indoor urban farming.
- Two soilless farming methods:
  - Hydroponic farming delivers nutrients directly to plants without soil, which is replaced by nutrient-rich water.
  - Aquaponic farming is a combination of hydroponics and aquaculture, where fish waste is fixed by bacteria and provides nutrients needed by plants that act as bio-filters and maintain a clean environment for the fish.

Question: Are quantity and quality of crops different when using hydroponic verses aquaponic techniques?

Objective: In a hydroponic and newly established aquaponic system, compare:
- Water quality
- Basil (Ocimum basilicum) productivity
- Essential oil profiles from basil

Methods:

Experimental Design

- Aquaponic system (Maryville, TN) by ion chromatography.
- Hydroponic system (before fish and plants added)

- Four ml samples were collected from both systems on Days 11, 17, 24, and 28.
- Samples were analyzed by Cornerstone Analytics, (Maryville, TN) by essential oil profile analyses.

Water Analysis
- Full water quality analyses from samples collected every week

Basil Production
- Total extract (see below) was diluted to 10 mg/ml.
- One ml extracts were analyzed by GCMS by Cornerstone Analytics.

Essential Oil Extraction

- Leaves were harvested from basil leaves.
- Extract was provided by the Coyote Fund at Maryville College.

Discussion:

Conclusions:
- Hydroponic plants were more dense after 2 weeks.
- “Young” hydroponic plants were taller after 4 weeks.
- Essential oil composition is different in basil grown in the hydroponic and aquaponic systems.
- Hydroponic plants had higher concentrations of the identified essential oils.
- Higher concentrations of oils such as eugenol may be an indicator of stress.

Areas for Future Research:
- Comparison of morphometric data after a full growing season/aquaponics system has become more established (>6 months)
- Water quality analyses from samples collected every week
- Full essential oil profile analyses for individual plants
- Role of essential oils in stress and antibacterial defense
- Aphid pest damage differences between the systems (potential causes and solutions)

Literature Cited:

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