Seneca INNOVATION

Comparison of Organic and Inorganic Nutrient Levels in Arugula, Lettuce and Kale grown in the AEVA Indoor Garden

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JUST VERTICAL

Project Summary

In this second research collaboration between Just Vertical & Seneca Innovation, the goal was to compare the nutritional quality of select vegetables grown in Just Vertical's AEVA hydroponic growth units at a variety of growth conditions. This work is a first step towards being able to tune specific growing conditions to increase nutritional content of vitamins or minerals in produce grown at home.

Analysis was conducted on organic (vitamins, antioxidants) and inorganic (minerals) composition of the vegetables. To date, this project is ongoing and data analysis is still in progress.

About Just Vertical

Just Vertical uses science and a sustainability-focused mission to make our world a better place.

Just Vertical is more than just a local food movement. They have created an indoor garden that rapidly produces fresh food and preserves the earth's resources, all from a piece of furniture that feeds you. The AEVA line of indoor gardens are a fusion of the cutting edge science of vertical farming and mid-century modern design that allow anyone to grow their own food at home, all year long. All of the gardens come with built-in grow lights and watering systems so setting up is as easy as plugging in the system and putting in the provided plant pods. The Just Vertical AEVA units grow plants using 95% less water than traditional agriculture and no pesticides.

The AEVA Indoor Garden
Seedlings were grown for 4 weeks before transplanting to AEVA units, where they were grown 4 weeks before harvest and analysis.

Preliminary Results

Method Development

To investigate the organic nutrients of greatest consumer interest, this research focused on developing experimental methods for the main vitamin sources found in arugula, lettuce & kale: vitamins C, A, E & K.

Vitamin C is a water-soluble nutrient involved in numerous biological processes – including (but not limited to) protein metabolism, immune function, and neurotransmitter synthesis. In addition, it also possesses antioxidant function – by limiting damage from free radicals, it protects against development of certain cancers and cardiovascular diseases [1]. Fat-soluble vitamins dissolve in organic solvents and are stored in the liver and fatty tissues. This includes vitamins A, E, and K, which are important nutrients for maintaining normal vision, protecting cells from oxidative destruction, and proper blot clotting (respectively) [2].

For the mineral analysis, we took samples of all plants and analyzed to examine the macro and micronutrients. These included the micronutrients B, Cu, Fe, Mn and Zn, and the macronutrients Ca, K, Mg, Na, P and S. We also looked at Aluminum (Al) as a potential indicator of root health[3].

The plant samples were microwave digested and analyzed on an ICP-OES to quantify the mineral concentrations, and for the vitamins, the methods developed use a colourimetric spectrophotometer assay and HPLC-DAD.

Vitamin Analysis

Vegetables in AEVA indoor gardens were grown under conditions that varied nutrient levels, lighting duration, and watering frequency. AEVA-grown plants were also compared to produce available from a local grocery store. Conditions were compared to a baseline sample to observe their effect on vitamin levels. As shown in Figure 1, preliminary results show the vitamin K and A levels are higher in the AEVA grown produce than in the store-bought varieties.

Minerals Analysis

Figures 2 and 3 show the overall concentrations of Al and K, the latter thought to be one of the most crucial elements for plant growth, along with N and P[4]. The results are averages from all the conditions used to grow the plants. The baseline corresponds to the store-bought produce concentrations.

Figure 1. Vitamin Content of Fresh AEVA-Grown vs. Produce from Grocery Store

Figure 2. Analysis of aluminum (Al) in dry plant samples

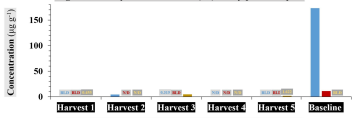
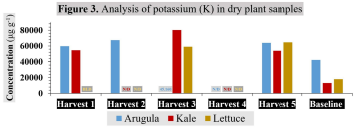


Figure 3. Analysis of potassium (K) in dry plant samples



*BLD = below limit of detection (not detectable in μg g^{-1}).
*N/D = no data available.

Conclusions

The preliminary results suggest that use of the AEVA hydroponic growth system produces vegetables with high nutritional content for the vitamins investigated. In particular, the increases in vitamins K and A suggest that further work in this area is warranted. For the minerals, AEVA units achieved plants of very low to no aluminum (Al) concentration compared to the store-bought produce, indicating that the plant roots were generally healthier. In addition, the AEVA-grown produce showed higher concentrations of potassium (K)

Results were based on initial analysis of the samples, so work is ongoing. Future steps will include repeating this test to confirm these trends. An additional focus will be on conducting data analysis on the preliminary results for the varied growth conditions.

[1]US Department of Health & Human Services. (2021, March 26). Vitamin C Fact Sheet for Health Professionals. US. Retrieved March 31, 2022, from https://ods.od.nih.gov/factsheets/VitaminC-HealthProfessional/
[2]Natural Research Council (US) Committee on Diet and Health. (1989). Chapter 11 Fat-Soluble Vitamins. In Diet and Health: Implications for Reducing Chronic Disease Risk. Washington, DC: National Academic Press. Retrieved March 31, 2022, from https://www.ncbi.nlm.nih.gov/books/NBK218749/
[3]Bojórquez-Quintal, E. (2017). *Aluminum, a friend or foe of higher plants in acid soils*. Frontiers. Retrieved August 11, 2022, from https://www.frontiersin.org/articles/10.3389/fpls.2017.01767/full#:%7E:text=Aluminum%20Promotes%20Nutrient%20Uptake&text=In%20different%20plant%20species%2C%20nitrogen,et%20al.%2C%201997).
[4]Hadrami, A. E. (2021, November 15). *Blog*. OMEX Agriculture Inc. Retrieved August 12, 2022, from https://omexcanada.com/blog/16-essential-elements

*Disclaimer: this research project is not yet completed. Contents describe preliminary results analyzed to-date.

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