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Microgreens: What Do Consumers Really Want?

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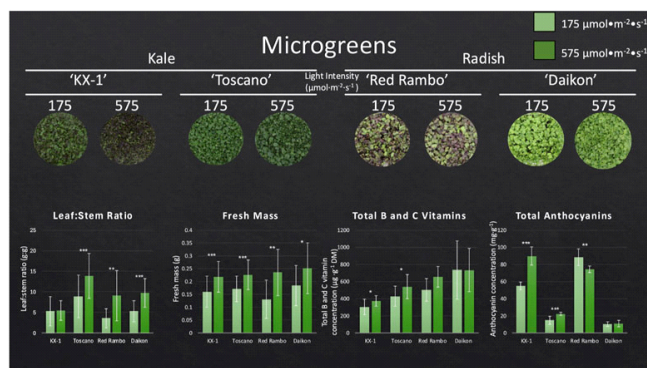


Figure 1. | Representative photographs of each species grown under high and low light intensity, and the effect of light intensity on coloration, leaf: stem ratio, fresh mass, total B and C vitamins and total anthocyanins.

Microgreens have become a staple crop of controlled environment agriculture, with about 19% of CEA operations producing microgreens globally. The versatility of their culinary applications, nutritional value, quick growth and high density make them attractive crops for producers and consumers alike. But why grow microgreens in controlled environments? The environmental controls offered by indoor or greenhouse production extend growing seasons and localize production in urban and rural areas. This localized production allows producers to target region specific market trends.

Controlled environments also provide the opportunity to capitalize on consumer preferences by altering growing conditions to achieve different responses in crops. Two common avenues to appeal to consumer preference are nutritional content and visual quality of microgreens. Light, one of the most frequently altered growing conditions, can affect the nutritional content and visual quality of microgreens, and potentially increase yields. But given that light is one of the highest expenses in controlled environment agriculture, it's essential to target lighting conditions that produce a crop desirable to consumers. This article will focus on the effects of two light intensities on the growth, nutritional quality and consumer preference and perception of radish and kale microgreens.

Experimental procedure

To explore a wide range of possible microgreen appearances, red and green cultivars of radish and kale were selected. The green cultivars were radish Daikon and kale Toscano, and the red cultivars were radish Red Rambo and kale KX-1. All cultivars were grown in growth chambers under broad-spectrum white target light intensities of 175 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ and 575 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$, for a 16-hour photoperiod (Daily Light Integrals of 10 and 33 $\text{mol}\cdot\text{m}^{-2}\cdot\text{d}^{-1}$, respectively), with a temperature of $\sim 23^{\circ}\text{C}$ and $\sim 60\%$ relative humidity.

In 28x28 cm trays of all-purpose Pro-Mix, 5.25 g of kale seeds and 11.5 g of radish seeds were separately

sown. The microgreens were fertilized with Jack's 12-4-16 at a concentration of 100 ppm N supplemented with 15 ppm MgSO₄. The trays were top-watered for the first watering to adequately wet the substrate and seeds, and were subirrigated for each subsequent watering. Radish microgreens were harvested seven days after sowing, and kale microgreens were harvested 14 days after sowing. Representative photos, growth and nutritional data were taken at harvest.

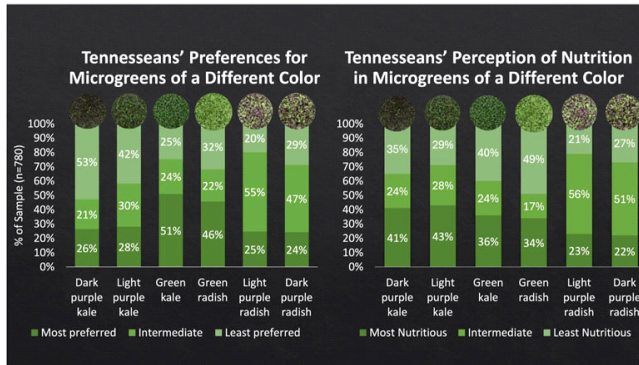


Figure 2. | Percentage of consumers' preferences and perception of nutrition in microgreens of different colors.

We crafted a survey using photos of dark purple radish (Red Rambo grown under 575 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), light purple radish (Red Rambo grown under 175 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), green radish (Daikon grown under 575 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), dark purple kale (KX-1 grown under 575 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), light purple kale (KX-1 grown under 175 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$), and green kale (Toscano grown under 575 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$). The survey was administered to 821 Tennessee consumers over 18 years old who identified as the primary grocery shopper in their household.

Consumer preferences and perceived nutrition of the microgreens were estimated by asking participants to organize images of all six different colored microgreens in order from:

1. most-preferred to least-preferred, and
2. most-nutritious to least-nutritious.

Consumers were asked their willingness to pay for the different microgreens and their preferred nutrition enhancement methods. Given that consumers may select different microgreens based on their own health goals, their health consciousness was elicited using a 5-point scale (1=strongly disagree, 5=strongly agree) to respond to health-related statements, such as "I consider myself very health conscious," "I usually read the ingredients on food labels," and "Good health takes active participation on my part." These health-related questions were synthesized into a health-consciousness score.

Results: Plant production

Let's start with what we all care about: yield. As expected, given that light is the primary driver of photosynthesis, providing higher light intensities resulted in higher fresh mass across all cultivars. Increasing light intensity also increased the leaf area (or cotyledon area) and leaf to stem ratio (mass:mass) in Toscano, Red Rambo and Daikon. Plant height in kale KX-1 was shorter when grown under the high light, but heights did not differ due to light in the other cultivars. In terms of nutrition, concentrations of Vitamin C were only significantly increased by increased light intensity in Toscano, and the total B and C vitamin concentrations (i.e., vitamin C, B1, B2, B3, B5, B6, B7, and B9) of the microgreens only increased in the kale Toscano and KX-1 cultivars. Vitamin C and total B and C vitamin concentrations were not affected by light intensity in radish, regardless of cultivar. Anthocyanin concentrations increased in kale when grown under the higher light intensity; interestingly, anthocyanin concentration decreased in Red Rambo under the higher light intensity. This decrease could be caused by the large increase in fresh mass observed under the high light intensities, likely increasing plant volume/thicker cotyledons, causing a decreased concentration. Anthocyanins contribute to the purple coloration in microgreens, and their concentration is reflected in visual appearance of

the microgreens (Figure 1).

Results: Consumer preference, perception and trends

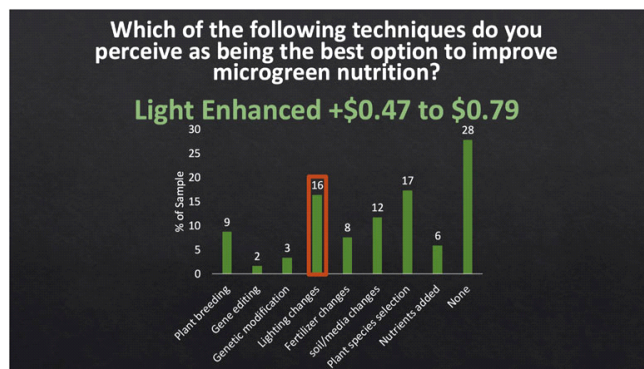


Figure 3. | Percentages of the strategies consumers perceive as being the best option to improve microgreen nutrition.

At a glance, there is an interesting relationship between the preferences of Tennesseans and their perceived nutrition of different colored microgreens. There appeared to be an inverse relationship between preferred microgreens and perceived nutrition content. Specifically, the two microgreens that consumers rated as “most preferred,” green kale and green radish, were also the two microgreens most frequently rated “least nutritious.” Additionally, the two microgreens that consumers rated as “least preferred” most frequently, dark purple kale and light purple kale, were both rated

“most nutritious” (Figure 2).

It appears that Tennesseans aren’t driven by nutritional components when selecting microgreens. The preference for green kale and green radish was reflected in consumers wallets, as consumers were willing to pay a \$0.52-\$0.66 premium for green microgreens and indicated they would need a \$0.50 discount to purchase dark purple microgreens relative to light purple microgreens. The complex relationship between consumer preferences and the perceived nutrition was particularly interesting. To investigate consumer perceptions of nutrition further, we compared their rankings of nutrition to the actual nutrition in the microgreens. After pairing this with the consumers health consciousness score, we found that consumers ability to correctly identify nutrition in microgreens had no correlation with their self-identified health consciousness across all demographics, including race, gender, education and urban/rural upbringing. This means that no matter the health consciousness rating, it did not impact their ability to perceive nutrition in microgreens. This implies there may be an opportunity to educate end customers about nutrition quality of microgreens to encourage selection of healthy options.

Despite the Tennessean consumers’ reservations for microgreens they deemed the most nutritious (i.e., purple), they were willing to pay premiums of \$0.47-\$0.79 for microgreens that have had their nutrients enhanced with light. Supporting evidence found that when comparing different production methods to heighten microgreen nutrition, they viewed lighting changes to be the best method to improve microgreen nutrition without any education regarding lighting and nutrition prior to the survey (Figure 3). Although it should be noted that 28% of the sample did not believe that microgreens nutrition needed to be improved.

Key takeaways

With the continuing rise in demand for organic foods and “natural” nutrient enhancement, our results indicate that leveraging light could serve this growing market. For controlled environment growers, this is good news. With the correct combination of cultivar selection and lighting regimen, coupled with marketing and advertising the added nutrition from lighting, growers could potentially gain substantial premiums on their products. Further, our results found that increasing light intensity can positively impact yield, leaf:stem ratios,

total B and C vitamins, and anthocyanin concentrations. For Tennessean consumers, green kale or radish such as Toscano and Daikon grown with a high light intensity are ideal.

While these results and recommendations may hold true in Tennessee, they are certain to differ across the country. If our results have shown anything, it's that consumers are complicated. With the continuation of consumer education regarding nutrition, controlled environment agriculture and the strategies to enhance the nutrition in crops, consumer trends may change. To ensure successful operations, understanding consumer perceptions and preferences should be an integral piece to determine what crops to produce and how to market crops to best meet consumer and grower needs. **IG**

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