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Zinc and iron biofortification of crops grown in a vertical farm

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With the growing global population and climate change, achieving food security is a pressing challenge⁽¹⁾. Vertical farming has the potential to support local food production and security. In the UK population females and younger adults appear to be particularly vulnerable to micronutrient shortfalls from food sources alone. Levels of micronutrient intakes including zinc and iron are below the recommended daily intake⁽²⁾. As a Total Controlled Environment Agriculture (TCEA) system, vertical farming employs hydroponics using a nutrient solution which offers opportunities to modulate nutrient uptake, and thus influence plant mineral and vitamin composition⁽³⁾.

In this study we aimed to determine the suitability of different crop types for soilless agronomic biofortification with zinc and iron to achieve biofortified crops.

In this study, we investigated the effect of the addition of 20ppm (+20 mg L⁻¹) of zinc (ZnSO₄) or iron (Fe-EDTA) to the nutrient solution on the growth and nutritional components in pea microgreens, kale microgreens and kale baby leaf plants. The growth conditions were kept identical throughout the treatments with photoperiod 18 h d⁻¹, temperature 20-22°C and relative humidity at 70-80%. Plant growth, mineral composition, glucosinolate content and protein content were evaluated. Results were analysed using ANOVA (p<0.05, Tukey's test).

It was determined that higher amounts of zinc in the nutrient solution resulted in significantly higher levels of zinc in all three crops (p<0.05), with increases of 205% in pea microgreens, 264% in baby leaf kale and 217% in kale microgreens compared to the control plants. Higher amounts of iron in the nutrient solution resulted in significantly higher levels of iron only in pea microgreens, with an increase of 38% (p<0.05). Neither dosing regimen negatively influenced the overall crop performance.

These results suggest that the three different crops are suitable for soilless biofortification with zinc and iron, although pea microgreens were the only crop that had a significant increase in iron upon iron-dosing.

References

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