Innovative breeding technologies in lettuce for improved post-harvest quality

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Abstract

Societal awareness of healthy eating is increasing alongside the market for processed bagged salads, which remain as one of the strongest growing food sectors internationally, including most recently from indoor growing systems. Lettuce represents a significant proportion of this ready-to-eat salad market. However, such products typically have a short shelf life, with decay of post-harvest quality occurring through complex biochemical and physiological changes in leaves and resulting in spoilage, food waste and risks to health. We review the functional and quantitative genetic understanding of lettuce post-harvest quality, revealing that few findings have translated into improved cultivar development. We identify (i) phytonutrient status (for enhanced antioxidant and vitamin status, aroma and flavour) (ii) leaf biophysical, cell wall and water relations traits (for longer shelf life) (iii) leaf surface traits (for enhanced food safety and reduced spoilage) and (iv) chlorophyll, other pigments and developmental senescence traits (for appearance and colour), as key targets for future post-harvest breeding. Lettuce is well-placed for rapid future exploitation to address postharvest quality traits with extensive genomic resources including the recent release of the lettuce genome and the development of innovative breeding technologies. Although technologies such as CRISPR/Cas genome editing are paving the way for accelerated crop improvement, other equally important resources available for lettuce include extensive germplasm collections, bi-parental mapping and wide populations with genotyping for genomic selection strategies and extensive multiomic datasets for candidate gene discovery. We discuss current progress towards post-harvest quality breeding for lettuce and how such resources may be utilised for future crop improvement.