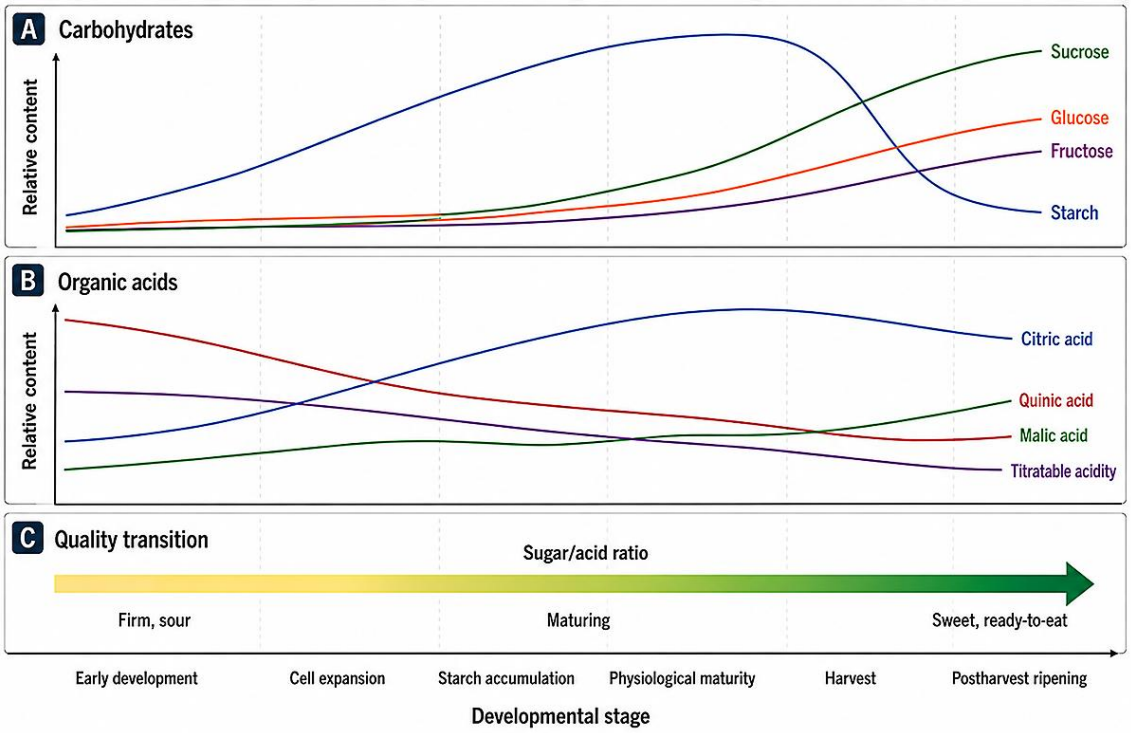


Figure 1 Dynamic changes in major sugars, organic acids, and quality attributes during kiwifruit development and ripening
Image caption: Relative changes in starch, sucrose, glucose, and fructose (A); Dynamic changes in citric acid, quinic acid, malic acid, and titratable acidity (B); As fruit development and ripening progress, the sugar–acid ratio gradually increases, accompanied by a transition from firm and sour fruit to sweet, ready-to-eat fruit (C). The curves shown in the figure represent general trends rather than specific quantitative values

During ripening, starch degradation becomes the main source of soluble sugar accumulation and is closely tied to the onset of softening. In postharvest fruit, starch breakdown precedes or accompanies strong increases in sucrose, glucose, and fructose, indicating that the conversion of reserve carbon into soluble sugars is a central ripening event. Enzyme and omics studies repeatedly implicate α-amylase, β-amylase, starch phosphorylase, and debranching enzymes in this process, with β-amylase emerging as a particularly important regulator (Tian et al., 2021). Regulation is not solely ethylene-dependent: cool temperatures at 5 °C–10 °C accelerate starch degradation and soluble solids accumulation even when ethylene perception is blocked, through an AcPUB11–AcCTS1–AcBAM3 module (Li et al., 2026). Ethylene still contributes, however, because treatment represses the transcriptional repressors AdVAL2 and AdKAN2 and upregulates BAM genes, thereby accelerating early starch degradation (Tong et al., 2024). Conversely, blue light delays ripening by suppressing starch degradation, amylase activity, and total soluble solids accumulation (Xu et al., 2024).

3.2 Sucrose metabolism and sugar interconversion

Sucrose metabolism in kiwifruit depends mainly on the balance between sucrose synthase and sucrose phosphate synthase, which together regulate sucrose cleavage, resynthesis, and cycling. Sucrose synthase shows high activity through much of fruit growth and is consistently higher than invertase during the growing season, supporting a dominant role in cleavage of imported sucrose (Chen et al., 2017). In growing 'Hayward' fruit, sucrose synthase activity is tightly associated with relative growth rate and is co-regulated with fructokinase and UDP-glucose pyrophosphorylase, linking sucrose cleavage directly to sink strength and carbon utilization. Nardozza et al. (2017) used *Actinidia chinensis* var. *deliciosa* 'Hayward' to compare CPPU-induced fruit enlargement under normal and high carbon supply conditions. The study found that CPPU significantly increased fruit fresh weight and elevated glucose and fructose levels. At 49 days after anthesis (49 DAA), the aquaporin gene *PIP2.4* was markedly upregulated. By contrast, SPS remains relatively low during earlier developmental stages and rises near maturity and ripening, when sucrose synthesis from starch-derived substrates intensifies (Kang et al., 2021). Feeding