

‘Sweetheart’ and 39%–188% in ‘Lapins’, while reducing respiration, membrane lipid peroxidation, ascorbic acid degradation, titratable acidity loss, decay, and pitting (Wang et al., 2014). In Chinese cherry, exogenous calcium decreased malondialdehyde content and relative electrical conductivity while increasing antioxidant enzyme activities, which supports a membrane-protective role beyond simple wall strengthening (Wu et al., 2023). Combined pre- and postharvest calcium gluconate similarly suppressed respiration and delayed losses of firmness, acidity, sensory quality, and decay during cold storage, although responses varied with calcium source and treatment sequence (Erbaş and Koyuncu, 2023).

5.2 Improvement of resistance to cracking and decay

Nutrient management also affects shelf life indirectly by reducing skin failure before or after harvest and by limiting subsequent microbial invasion. This relationship is important because cracked fruit are much more vulnerable to fungal infection and commercial rejection (Çolak et al., 2025).

Calcium consistently reduces cracking in many cherry studies, although the magnitude varies. Preharvest foliar calcium treatments reduced cracking by 38%–66% in ‘0900 Ziraat’, with calcium chloride and calcium hydroxide among the most effective compounds, and calcium chloride also increased firmness by about 12% relative to other compounds (Eroğul, 2014). More recent orchard trials found that calcium- and potassium-based foliar treatments reduced cracking and improved firmness and weight retention during storage, while dormant-bud calcium application also lowered on-tree cracking and improved harvest quality traits (Michailidis et al., 2021; Varaldo and Giacalone, 2025). Boron contributes mainly through its interaction with calcium transport and wall structure. Under boron-deficient soil, calcium allocation shifted toward roots and pits, while calcium in the edible flesh and peel was higher under boron-adequate conditions, indicating that boron deficiency weakens the calcium status most relevant to cracking resistance (Bonomelli et al., 2025).

Reduced decay after calcium treatment appears to reflect both stronger tissues and slower physiological breakdown. Calcium-treated ‘Celeste’ fruit had lower decay incidence than controls (Belge et al., 2017). Hydro-cooling with calcium chloride decreased decay in both ‘Sweetheart’ and ‘Lapins’ cherries, alongside lower membrane lipid peroxidation and respiration (Wang et al., 2014). A mechanistic explanation is that calcium promotes pectate formation, strengthens intercellular adhesion, and suppresses wall-degrading enzymes, which makes pathogen penetration more difficult (Çolak et al., 2025). Nutrient balance also matters because excess nitrogen appears to favor softening, and calcium responses are often inconsistent when uptake into fruit is limited or mineral ratios are unfavorable (Winkler and Knoche, 2019).

5.3 Interaction with storage conditions

Nutrient effects on shelf life are strongest when considered together with storage environment, especially low temperature and modified atmosphere packaging. The evidence supports synergy between calcium status and storage technology, but also shows that storage conditions can either reveal or mask nutrient benefits (Matteo et al., 2022; Liu et al., 2025; Cui et al., 2025).

Cold storage preserves cherries, but fruit nutrient status strongly influences how well quality is maintained over time. Early crop load reduction improved storage condition after 45 days at 0 °C, and early foliar CaCl₂ sprays improved firmness under high crop load, indicating that preharvest calcium management can improve cold storage performance before fruit enter storage (Matteo et al., 2022). Calcium-treated fruit generally lose less weight and maintain greater firmness during refrigerated storage, as shown in ‘Celeste’, ‘Regina’, and ‘Sweetheart’ studies (Varaldo and Giacalone, 2025). Combined pre- and postharvest calcium gluconate was especially effective during three weeks of cold storage, giving the best suppression of respiration and the slowest losses of firmness and sensory quality (Erbaş and Koyuncu, 2023).

Modified atmosphere packaging improves cherry storage by lowering respiration and water loss, and nutrient treatments can enhance these benefits. MAP significantly retarded weight loss and, when combined with a preharvest treatment, helped maintain firmness and reduce decay during cold storage and shelf life in ‘0900 Ziraat’