Rapid detection of preexisting internal *Leuconostoc spp*. spoilage populations in fresh-cut carrots during storage

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During an extended period of abnormally short quality retention in mixed component packaged salads, due primarily to rapid decay, a root-cause investigation was undertaken. From an initial investigative assessment, this study focused on identification for the primary underlying microbiological cause and validation of a rapid detection screening of raw material. Analysis of several lots of raw, unprocessed product, approx. 6 cm abrasively peeled carrot plugs, revealed the accumulation of an aqueous slime in the shipping bag void space and around the extremely softened plug surfaces. This premature diagnostic sign of lactic acid bacteria (LAB) spoilage, specifically *Leuconostoc spp*. (*Ln*. spp.), developed in cold storage (2.5°C) after two weeks. Efforts were undertaken to determine whether the *Leuconostoc* was internalized in raw material or primarily environmental contamination with a proliferating reservoir of LAB in the primary processing and packaging environment. Polymerase chain reaction (PCR) primers specific for the amplification of sequenced regions of the *Leuconostoc spp*. and of the *Leuconstoc mesenteroides* 16S ribosomal RNA gene confirmed the taxonomic identity. Total initial LAB and *Leuconostoc* bacterial populations isolated from symptomatic carrots ranged from $\log_{10}$ 7.5–8.5 and $\log_{10}$ 3.5–4.0 CFU/g carrot tissue weight respectively, and increased $\log_{10}$ 2 CFU/g and $\log_{10}$ 3.5 CFU/g respectively in population density on asymptomatic and symptomatic raw carrot material during two week refrigerated storage. The progression of cold-storage spoilage symptoms of raw, asymptomatic carrot plug tissue correlated with quantifiable population growth of *Leuconostoc* populations.

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