Title Dynamics of condensation in plastic film packages for fruit

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Abstract

Water condensation on the surface of packed fruit results in disturbance of the external appearance, promotes the growth of micro-organisms, and accelerates deterioration. Even at low temperatures, fluctuations of ambient air causes condensation on surfaces due to comparatively high air humidity inside film packaging. Objective of the present study was to determine condensation dynamics and intensity within a plastic film packaging for fruit under changing environmental conditions. The experimental packaging unit consisted of a gas-tight plastic tray. A commercially available polyester polymer film was applied to cover the tray. The packaging unit with a defined number of Japanese plums was stored in a temperature-controlled climate chamber. Inside the packaging, the high humidity was measured with a calibrated humidity sensor. In total, 10 calibrated, extremely stable temperature sensors with low-energy input and very small sensor heads were used to measure the internal air and surface temperatures (fruit surface, fruit to fruit, film surface, fruit to film). Every surface temperature sensor was in direct contact with the respective object to be measured. It could be shown that water condensation occurs time-delayed to external temperature fluctuation and superposes itself on the surface of the fruit, on the inner film surface, and on the inner tray walls with varying intensities. Retention time and intensity were investigated as the substantial components of condensation. In addition to the external temperature cycle (cycle time, temperature amplitude), the external mass transfer (flow conditions, external air humidity) and the air volume within the packaging were taken into consideration. In particular, external flow conditions and temperature amplitudes, and the inner air volume affected condensation on the inner film surface. In contrast, condensation on fruit surfaces is generated primarily by temperature amplitude and cycle time.