Cellulose-based film for vegetable packaging application: case study on broccoli

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Modified atmosphere packaging (MAP) has proven to be a key technology for extending shelf-life of fresh fruits and vegetables. The main disadvantage of MAP is the extensive use of petrochemical-based films. Replacing these films with bio-based and biodegradable alternatives could reduce environmental impact of plastics. The aim of this work was to evaluate the suitability of a cellulose-based film for broccoli packaging and to study its effect on product quality.
Broccoli heads (cv. Legacy) were cut into florets, washed, disinfected (NaClO), dried and packaged in micro-perforated polypropylene (PP) and micro-perforated cellulose-based film (Cellulose). Broccoli packaged in macro-perforated polypropylene was used as control (C). Samples were stored at 4 °C throughout 21 d. Package internal O2 and CO2 concentrations, mass loss (ML), instrumental color and sensory attributes (color, odor and overall appearance) were evaluated during storage. Two-way ANOVA considering packaging condition, storage time and interactions was performed, and when significant differences were observed Tukey's test was applied ($p < 0.05$).
Cellulose samples reached significantly higher CO2 (5.5%) and lower O2 (13.9%) equilibrium concentrations compared to PP samples (2.9% and 18.0% respectively). Gaseous composition inside cellulose packages was closer to recommended values for broccoli storage. Broccoli in cellulose-based film showed the highest ML at the end of storage period (15.5%) compared to PP (1%) and C samples (8.9%). However, this higher ML did not have a significant impact on sensory quality, since no significative differences were found on sensory attributes between Cellulose and PP samples. Broccoli in MAP retained color of freshly harvested broccoli (L*=43.1, hab=115.1) regardless of applied packaging film, while C samples showed a significative increase in L* (to 57.9) and decrease in hab (to 87.2). Therefore, micro-perforated cellulose-based film could be a viable packaging alternative for broccoli, positively impacting the reduction of plastic waste. Additional studies should be considered to determine the suitability of this film for packaging broccoli at other storage temperatures.