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Pectin-Nanocellulose Coatings and Films for Sustainable Food Packaging

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The shelf life of perishable foods in grocery stores can be extended significantly by modified atmosphere packaging (MAP), which is designed to regulate internal humidity and oxygen content. Currently, MAP (and food packaging in general) is dominated by single-use plastics that provide flexibility, short-term durability, and protection from changes in air quality, but which are also major contributors to the global crisis of plastics pollution. Traditional alternatives to plastic such as glass, metal, and paper are less appealing because of their higher weight and cost or inferior performance relative to plastic packaging. However, global pressure to reduce the prevalence of single-use plastics is clearly mounting, and the need for sustainable alternatives is now urgent. Leading bioplastics such as polylactic acid (PLA) and polyhydroxyalkanoates (PHAs) offer some appeal but suffer from poor thermal stability and challenges in recycling or composting.

Pectin, a polysaccharide that is traditionally used as a gelling agent in foods, is an intriguing candidate for MAP applications. Pectin by itself has low mechanical strength and tends to absorb moisture, however its properties become much more useful when combined with cellulose nanofibers (CNFs) into a composite material. Researchers at Purdue University have developed pectinâ€“CNF composites into a new type of breathable and biodegradable plastic for MAP of fruits and vegetables. This packaging alternative is mechanically robust at high humidity and regulates moisture loss that can preserve the textural qualities of fruits. The biodegradable pectinâ€“CNF composites can also slow down oxidation and the browning of sliced fruits. By sealing perishable foods in pectinâ€“CNF based packaging, it is possible to reduce both food spoilage and further accumulation of plastic waste.

Technology Validation:

To illustrate the moisture-preserving capacity of the novel composite, approximately 200 g of strawberries were packaged in parchment boxes coated with pectinâ€“CNF and stored under refrigeration for three weeks.

Strawberries stored in the MAP box experienced 20% lower moisture loss than those in the uncoated control due to the moisture-absorbing qualities of the pectin composite. Moreover, the strawberries in the MAP box retained their shape and luster, whereas most of those in the control box were dull and exhibited shrinkage.

Advantages:

-Reduced moisture loss from fruits after 3 weeks of refrigeration

-Natural antioxidant capacity that prevents or reduces oxidative spoilage

-Excellent tensile strength and toughness at high humidity (80% RH)

-Inexpensive feedstocks (pectin is a waste byproduct from apple and orange peel)

-Fully biorenewable and biodegradable, and a sustainable alternative to conventional plastic-based packaging

-Humidity regulation and moisture retention are imperative for food preservation in stores

TRL: 4

Intellectual Property:

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