Development of sustainable hybrid hydrocolloid films with improved water vapor barrier

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Abstract
Research concerning hybrid hydrocolloid films (HHF) for increasing food shelf life has increased in recent years. HHF are produced from biopolymers (polysaccharides, proteins, and lipids) incorporated with active compounds (e.g. essential oils). Despite their advantages (e.g. biodegradability, non-toxicity, biocompatibility), HHF have some unsolved drawbacks such as low water vapor barrier and reduced mechanical properties.
Aims: The aim of this study was to develop sustainable HHF using pectin and rosemary oil-loaded solid lipid nanoparticles (SLN) for improving the moisture barrier. Physical, mechanical, thermal, and morphological properties were determined to characterize developed films.
Results: The water vapor permeability of pectin films decreased by over 90% upon SLN incorporation, thus improving the moisture barrier. This can be attributed to the SLN being nanoscale particles with platelet-like shapes that additionally are crystalline and hydrophobic. Together, these features reduce the hydrophilicity of pectin films and lead to the formation of tortuous paths slowing down the diffusion of water molecules through the films. All films with and without SLN were transparent with an immediate complete disintegration in water. Upon SLN addition, the visual aspect of the films changed from very smooth to more structured as seen in SEM images. However, heterogeneities were not observed indicating a complete integration of SLN into the pectin matrix. In terms of mechanical properties, all pectin films showed mainly elastic behavior.
Conclusion: Thus pectin/SLN films were successfully developed with tuned properties. Further studies for testing their bioactivity (e.g. antioxidant and antimicrobial) and sensory effects in food matrices should be further performed.

Keywords: Edible films, Citrus pectin, Rosemary essential oil, Nanoencapsulation, Solid lipid.