**Development of plant-based multilayer antimicrobial films for sustainable food packaging**

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People are consuming more fresh fruits and vegetables than ever before. However, the susceptibility of fresh produce to microbial contamination presents great challenges to transport and storage. It can be helped by antimicrobial packaging enriched with essential oils, whereas releasing essential oils results in a loss of antimicrobial activity. To program their release behavior, multilayer films were fabricated by alternatively depositing soy protein isolates (SPI) and high methoxy pectin (HMP) on a substrate, using spray coating, and nano-emulsion droplets containing the active component were incorporated in the primary layer. Carvacrol, one of the main components in essential oils from certain herbs, was chosen to model the release behavior in such a system. The surface morphology and 3D structure were imaged via atomic force microscopy (AFM), multiphoton microscopy, and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM-EDS). The release profile was characterized by gas chromatography-mass spectrometry (GC-MS). The transparent films were fabricated using spray coating with the successful formation of the layer-by-layer structure. The structure could delay the release by varying the number of add-on layers while maintaining the preservation efficacy for strawberries at room temperature. This approach could provide a promising alternative to control the release of essential oils in active packaging, thereby protecting fresh produce from microbial damage in an environmentally friendly way.