Abstract

Food spoilage and microbial contamination are critical challenges to global food safety. Essential oils offer a natural antimicrobial alternative to synthetic preservatives, but their volatility and instability hinder direct application. To address this, their integration into active packaging materials presents a promising solution. This study investigates the development of biodegradable antimicrobial packaging films incorporating 2% and 4% lemon myrtle essential oil, extracted from *Backhousia citriodora*, an Australian native plant rich in citral. Sodium alginate films were produced by casting, and their effect on the microbial load (Total Plate Count, Yeast and Mould, and Psychrotrophic bacteria) of refrigerated chicken breast was evaluated over three days. The release of citral was semi-quantified using gas chromatography-flame ionisation detection. The 4% LMEO film significantly inhibited microbial growth, reducing the Total Plate Count by 2.8 log CFU/g on day 1 and 1.7 log CFU/g on day 3 compared to the control ($p < 0.001$). It also suppressed yeast and mould and psychrotrophic bacteria by >1 log CFU/g by day 3 ($p < 0.001$). Conversely, the 2% LMEO film was ineffective. Unexpectedly, GC-FID analysis revealed that 2% LMEO films released significantly more citral than the 4% films. Furthermore, a paradoxical positive correlation was found between citral release and TPC ($r \approx 0.75$, $p < 0.001$), likely due to shifts in the microbial community. Overall, the 4% LMEO-alginate film is a potent antimicrobial packaging system. However, further optimisation is required to improve the citral release profile and address sensory changes, such as meat discolouration, to ensure commercial viability.

Keywords: *active packaging, antimicrobial, essential oil, food safety, lemon myrtle, sodium alginate*